BIRTH RATES OF THE WHITE POPULATION IN THE UNITED STATES, 1800-1860

AN ECONOMIC STUDY

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By
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YASUKICHI YASUBA

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BIRTH RATES OF THE WHITE POPULATION IN THE UNITED STATES, 1800-1860

An Economic Study

INTRODUCTION

It has been pointed out by many social scientists that compared with the trends in the birth rates in most European countries the trend in the birth rate in the United States was unique on two accounts. First, it has been said that the birth rate in the United States was much higher than in Europe in the early decades of the nineteenth century or earlier. Second, it has been suggested that the birth rate in the United States started to decline at latest in the beginning of the nineteenth century, while in most European countries, except France and Ireland, a steady fall in the birth rate did not begin until after 1870. Since the United States did not have a national system of registering births in the nineteenth century, the birth rates in United States for these early years had to be estimated indirectly from various sources.

The first major objective of this study is to ascertain beyond doubt whether the birth rate in the United States at the beginning of the nineteenth century was considerably higher than in Europe and whether the fall in the birth rate in the United States started earlier than in most European countries.

With this objective in mind, various methods of estimating the levels and trends of fertility are examined in Chapter I. The basic measures of fertility adopted are the white crude birth ratio, or the number of white children under 10 years of age per 1,000 whites, and the white refined birth ratio, or the number of white children under 10 years of age per 1,000 white women aged 16-44.[1] The colored population is excluded from the scope of the study, because its age-classification before 1850 was not detailed enough. The period of this study is limited largely to 1800-1860. The period before 1800 is excluded because census statistics before 1800 are not detailed enough to allow computation of the crude and refined birth ratios. The period after 1860 is excluded because

[1] In Chapter IV, Sections 1 and 2, where the fertilities of women in different countries are compared, a more conventional measure of fertility, the number of births per 1,000 women aged *15*-44 (the refined birth rate) is used. In Chapter IV, Section 3, where fertility data for New York counties are analyzed, the number of births per 1,000 women aged *16*-44 is used.

it has been covered by Bernard Okun's study.[2] The crude and refined birth ratios in the United States will be seen to have declined consistently, though not steadily, since 1800.

Chapter II describes the trends and differentials in the birth ratios of states and territories. It will be seen that there were wide differentials in the birth ratios of the white population of states and territories and that the birth ratios of states and territories decreased almost in every decade. The existence of wide and still widening geographical differentials in the birth ratios in 1800 suggests that the birth ratios of older states which were lower than those of newer states and territories in 1800 may have started to fall much before 1800. This inference will be partially verified by the colonial and continental census records.

In Chapter III, mortality records are examined to see whether differentials and trends in child mortality largely accounted for the differentials and trends in the birth ratios. It will be found that a part, but only a small part, of the differentials in the birth ratios may have been due to differentials in mortality. The child mortality rate in the United States may have increased in the few decades preceding the Civil War but not so rapidly as to explain to a considerable extent the fall in the refined birth ratio. Other factors which may have affected the birth ratios such as the extent of underenumeration of young children and the rate of increase of yearly births tended to mask the differentials and trends in the birth ratios. Thus, there is no doubt about the direction of the change in the birth rate over time; and the relative levels of the birth ratios of states and territories may be judged to represent approximately the relative levels of their birth rates. It is also made clear that the birth rate in the United States in the period 1800-1860 was much higher than in Western Europe.

These demographic facts established, our next task is to explain why, or how, the birth rate in the United States was higher than in Europe and why, or how, the birth rate in the United States started to fall earlier than in Europe.

P. K. Whelpton in an article published in 1928 [3] grouped states and territories into three classes according to the proportion of their gainfully-employed population engaged in agriculture.

[2] Bernard Okun, *Trends in Birth Rates in the United States since 1870*, Baltimore 1958.

[3] P. K. Whelpton, "Industrial Development and Population Growth," *Social Forces*, March and June 1928, 6.

Finding that white fertility was lower in industrial than in agricultural states in every census year since 1800, he concluded that "since 1800 industralization has cut down the rate of natural increase of population." [4] In recent years, doubts have been cast upon this conclusion [5] on the ground that the United States in the early decades of the nineteenth century was still in an incipient stage of industralization-urbanization and the the progress of industralization-urbanization was rather slow during these decades.

To shed more light on the nature of the high but decreasing birth rate in the United States the effects of age-distribution and marriage customs—the age at and the incidence of marriage—on the birth rate are analysed in Chapter IV. Major findings in this chapter are (1) that much, though not all, of the difference between the refined birth-rates of America and Europe in the late eighteenth and early nineteenth century can be explained by a difference in marriage customs, (2) that the difference in the refined birth rate in different localities of comparable ruralities in comparable periods within the United States can be accounted for largely by marriage customs, and (3) that the contribution of the change in marriage customs towards reducing the refined birth rate in the United States seems to have been considerable but smaller than in other New World countries such as Canada and Australia. Apparently the fall in intramarital fertility started much earlier in the United States than in most other countries except France. The effect of the age-distribution of women within child-bearing ages will be seen to have been rather minor.

In the final chapter, various hypotheses concerning the socio-economic determinants of fertility are examined. Socio-economic variables analysed are largely limited to those of which quantitative data are available by state or territory, such as the proportion of urban population, the proportion of gainfully employed persons engaged in non-agricultural pursuits, population density, income level, and the number of the foreign born.

It is found that industralization-urbanization, population density and per capita income were all negatively and significantly correlated with the white refined birth ratio. Generally speaking the correlation betwen population density, or the number of persons

[4] *Ibid.*, p. 467.

[5] Okun, *op. cit.*, p. 65; H. Yuan T'ien, "Demographic Aspect of Interstate Variations in American Fertility, 1800-1860," *The Milbank Memorial Fund Quarterly*, January 1959, 37, p. 50.

per 1,000 acres of arable land, and the refined birth ratio was closer than the correlations between the degree of industralization (or urbanization) and the refined birth ratio or between the average income per person aged 10 or older and the refined birth ratio. However, since the correlation between population density and the refined birth ratio became weaker over time, the absolute value of its coefficient became approximately the same as that of the coefficient for industralization-urbanization and the refined birth ratio towards the end of the period under consideration.

The correlation between average income and the refined birth ratio was much weaker. Moreover, the correlation disappeared when observations were standardized with respect to the degree of urbanization. A closer look at the relationship revealed that average income, in 1840, might have been inversely associated with fertility in more urbanized areas and positively associated with fertility in rural areas.

There was a close correlation between the change in population density and the change in the refined birth ratio during the first half of the period under consideration. The association became weaker afterwards. There seems to have been little correlation between the change in the degree of urbanization and the change in the refined birth ratio during the first half of the period. During the latter half, a positive association emerged but the coefficient of standardized rank correlation was not very large. It was after 1860 that a close association between the change in the degree of urbanization and the change in the refined birth ratio emerged.

Though it seemed reasonable to assume that immigration, by reducing the availability of easily accessible land and facilitating industrialization and urbanization, helped reduce native fertility, this hypothesis was not strongly supported by the statistical data available. A stronger hypothesis that immigration was the most important cause of the fall in native fertility did not seem to be tenable.

Though the scarcity and limited reliability of data and the limited scope of this study do not allow us to draw a definite conclusion, the following set of hypotheses seems to explain most plausibly, within the framework of the data examined, the levels and trends of the refined birth ratios in American states and territories in the period 1800-1860.

(1) In the early decades of the nineteenth century, the availability of easily accessible land within the settled areas was a major determinant of the refined birth ratio of the white population in the United States. Fertility tended to be higher in places where it was easier to obtain new land nearby and, conversely, it tended to be lower in places where there was less free or cheap land. Over time, as the difficulty of obtaining new land within the settled areas increased with the growth of population, fertility was reduced.

(2) Industralization-urbanization was not an important determinant of fertility in the first few decades of the nineteenth century. It is only after about 1840, when the process of industrialization-urbanization was accelerated, that industrialization-urbanization assumed a major role as a determinant of fertility. Though the availability of easily accessible land continued to be a factor affecting fertility, its importance became secondary after the middle of the nineteenth century.

It must be emphasized that these hypotheses do not exclude the possibility of the existence of other major determinants of fertility. In fact, the relatively low levels of the refined birth ratios in new states and territories in 1860 compared with those in new states and territories in 1800 suggest that other factors—for example, the propagation of the knowledge of contraceptive techniques and the decline in the importance of religious inhibitions—may have been at work.

CHAPTER I

ESTIMATES OF THE LEVELS AND TRENDS OF FERTILITY IN THE UNITED STATES, 1800-1860

Although the national system of birth registration was not introduced until later, there are several methods of estimating the levels and trends of fertility for the period before 1860. In this chapter these methods are reviewed and examined.

1. *Estimates from the Census Statistics of Population by Age*

Perhaps the most reliable method of estimating the levels and trends of fertility is to use the census statistics of population classified by age group. Federal censuses gave the number of children under 10 for 1800, 1810, and 1820 and the number of those under 5 for 1830 and later. In 1850 and thereafter, the number of children under 1 was also reported but, owing partly to heavy underenumeration in this age class and partly to the desire for comparability of the ratios throughout the nineteenth century, most demographers have preferred to use the number of children under 5 or under 10. They have expressed these numbers as percentages either of the total population or of the number of women of child-bearing age, and the downward trend of the ratio has been recognized.

As early as the 1840's George Tucker called attention to the fact that the ratio of white children under 10 years of age to white females had declined continuously from 1800 to 1840, and he indicated that this implied a decline of the birth rate.[1] Ezra C. Seaman, a few years later, in addition to repeating the contention of Tucker noted that the proportion of children under 10 among

[1] George Tucker, *Progress of the United States in Population and Wealth in Fifty Years*, New York 1843, pp. 44, 90-92.

the total population was greater in western states than in eastern states.[2]

Later, toward the end of the century, as a declining birth rate became manifest in several European countries, John S. Billings, pointed out the continuous decrease in the number of children under 1 and also in the number of those under 5 per 1,000 population between 1860 and 1890, and concluded that the birth rate had declined in the United States during that period.[3]

Walter F. Willcox, in a Census Bulletin published in 1905,[4] extended the period covered as far back as the census age-classification allowed. For example, he calculated the number of white children under 5 per 1,000 white women aged 15-49 as far back as 1830 and the proportion of white children under 10 in the white population as far back as 1800. He further calculated for 1880 and 1890 the ratio of children to women separately for cities having at least 25,000 inhabitants and other areas by states and divisions. The urban-rural differential was shown strikingly by these computations.

In 1911, Willcox constructed another series, showing the number of children under 5 years of age per 1,000 women aged 16-44 from 1800 onward, and demonstrated that the decline of the birth rate set in at least as early as 1810.[5] Because the system of classification used in the census was altered several times during the nineteenth century,[6] it was sometimes necessary for Willcox to

[2] Ezra C. Seaman, *Essays on the Progress of Nations*, New York 1846, pp. 362-364.

[3] John S. Billings, " The Diminishing Birth Rate in the United States," *Forum*, June 1893, 15, pp. 470-475.

[4] United States Bureau of the Census, *Proportion of Children in the United States*, Bulletin 22, Washington 1905.

[5] Walter F. Willcox, " The Change in the Proportion of Children in the United States and in the Birth Rate in France during the Nineteenth Century," *Publications of the American Statistical Association*, March 1911, 12, pp. 491-495.

[6] In the censuses of 1800, 1810, and 1820 the white population was classified into five age-groups for each sex, that is, 0-9, 10-15, 16-25, 26-44, and 45 and upward. The colored population was not classified by age in the Second and Third Censuses but in 1820 four classes of under 14, 14 to 25, 26 to 44, and 45 and upward were used.

In the next two censuses, the white population was classified, for each sex, into quinquennial age-groups under age 20 and decennial age-groups for age 20 and upward. The number of classes for the colored population was increased, but classification was not yet so detailed as in the case of whites. Six classes for the free colored and slaves, separately, were under 10, 10 to 23, 24 to 35, 36 to 54, 55 to 99, and 100 and upward.

The method of classification by age remained unchanged for the white population in 1850 and 1860 except for the addition of a class of under 1 year of age. However,

estimate the number of children, or of women, belonging to certain age-classes.

For the white population, the number of children under 5 was given by censuses of 1830 and later. Willcox, assuming that the proportion of children under 5 among children under 10 was the same in 1800, 1810, and 1820, as in 1830, estimated the number of children under 5 for the three earlier censuses by applying the ratio of children under 5 to children under 10 in 1830 to the number of children under 10 in each preceding census.

As for women of child-bearing age, 16 to 44 was adopted by Willcox instead of the conventional 15 to 44, because the former was easier to estimate. The number of white women in the former age-class was given in the censuses of 1800, 1810, 1820, and 1880 and thereafter. For 1870, the numbers of women aged 15-17 and 18-44 were given. The number of women aged 16-17 in 1870 was estimated on the assumption that the ratio of women aged 16-17 to women aged 15-17 was the same in 1870 as in 1880. Similarly, the proportion of women aged 16-19 among women aged 15-19 and the proportion of women aged 40-44 among women aged 40-49 in 1830, 1840, 1850, and 1860 were taken to be equal to their comparable proportions in 1870.

The same assumption—that any unknown ratio of a sub-class to a larger class is the same as the comparable known ratio in the nearest census—was applied to the colored population.

The result of the computation is summarized in Table I-1. It clearly shows the continuous decline of the ratio of children under 5 to women of child-bearing age.

Two objections might be raised against this computation. First, before 1850, the colored population was not classified into detailed enough age-classes to warrant the computation of the ratio of children of all races to women of all races. Second, to compute the average of birth rates of two groups so different socially and culturally from each other might result in cancelling out conflicting trends.

Most later demographers, aware of these difficulties, either

for the first time in the history of the census, the same age classification as for whites was used for the free colored and slaves.

In 1870, population was tabulated by single year of age under 5, by five year interval between ages 5 and 79—except 15-19 which was subdivided into two classes of 15-17 and 18-19—and by ten year interval for age 80 and upward. It was not until 1880 that the population was classified by single year of age.

confined their attention to the white population or treated the white and the colored populations separately. Warren S. Thompson and P. K. Whelpton in their *Population Trends in the United States* estimated not only the number of children aged 0-4 per 1,000 women aged 15-44, separately for the white and the colored, but also crude and refined birth rates for the white population.[7] Their method of estimating the size of a sub-class was the same as the one used by Willcox.

TABLE I-1

NUMBER OF CHILDREN UNDER 5 YEARS OF AGE PER 1,000 WOMEN AGED 16-44: UNITED STATES, 1800-1900

1800	976
1810	976
1820	928
1830	877
1840	835
1850	699
1860	714
1870	649
1880	635
1890	554
1900	541

Source: Willcox, *loc. cit.*, p. 495.

In estimating the number of births, the number of children under 5 given by, or estimated from, a census was first increased to allow for underenumeration.[8] Although it was suspected that counting of children became more accurate in later censuses, it was not felt that there was any means of allowing for the improvement. Consequently, it was assumed that the relative amount of underenumeration in each census prior to 1920 was the same as in 1920. (5% for whites.[9]) The Massachusetts Life Tables were then used to estimate the number of total births during five years ending on a census date, from which the number of births for five years centering on a census year was computed by straight

[7] Warren S. Thompson and P. K. Whelpton, *Population Trends in the United States*, New York 1933, pp. 263-264.

[8] For the various methods of estimating the amount of underenumeration the reader is referred to Appendix A in W. H. Grabill, Clyde V. Kiser, and P. K. Whelpton, *The Fertility of American Women*, New York 1958, pp. 406-413.

[9] The figure is the estimate by the Scripps Foundation. Cf. Thompson and Whelpton, *op. cit.*, p. 263.

line interpolation—" e. g., adding to births during five years ending on census of 1810 one-fourth of the increase between these births and births 10 years later gives estimated births for 5 years centering on 1810 Census." [10] Finally, crude and refined birth rates were obtained by dividing the one-fifth of the number of births by total population and by the number of women aged 15-44, respectively. The result of the computation for the white population is presented in Table I-2.

TABLE I-2

NUMBER OF CHILDREN UNDER 5 YEARS OF AGE PER 1,000 WOMEN AGED 15-44, AND CRUDE AND REFINED BIRTH RATES, FOR THE WHITE POPULATION: UNITED STATES, 1800-1930

	Number of children under 5 per 1,000 women 15-44	Crude birth rate	Refined birth rate
1800	952	55.0	278
1810	953	54.3	274
1820	905	52.8	260
1830	835	51.4	240
1840	797	48.3	222
1850	659	43.3	194
1860	675	41.4	184
1870	610	38.3	167
1880	586	35.2	155
1890	517	31.5	137
1900	508	30.1	130
1910	484	27.4	117
1920	471	26.1	113
1930	386	20.1	87

Source: Thompson and Whelpton, *op. cit.*, p. 263.

An objection may be raised against the application of the Massachusetts Life Tables. Massachusetts was much more urban than most other states throughout the nineteenth century and, in view of the large differential between urban and rural death rates, the number of births in the United States might have been considerably overestimated. Another source of error is the probable trend in mortality before 1855. Thompson and Whelpton apparently interpolated the death rate before 1855 from the Massachu-

[10] *Ibid.*, p. 264.

setts Life Table for 1855 and Wiggleworth's Life Table for a part of Massachusetts and New Hampshire in 1789. According to this procedure the death rate decreased continuously throughout the first half of the nineteenth century. But as we see in Chapter III, there are reasons to suspect that the death rate may have increased in this period. If this was the case, the birth rates and the decline in the birth rate in early years were overestimated by Thompson and Whelpton.

Thompson and Whelpton's method of interpolation created a consistent upward bias in their estimates of the birth rates due to the continuous influx of immigrants. Whereas "the average number of births for five years centering on a census year" should include only those births attributable to the population which either resided, or would have resided if alive, in the United States at the census date, the average number of births of Thompson and Whelpton included those attributable to immigrants who had come to the United States *after* the census date, whether the births had occurred here or abroad.

In Figure 1, if we take the age of persons on the *X* axis and the number of persons of a certain age on the *Y* axis, the number of births during five years ending on a census date, or area *AOBD*, can be computed from the number of persons under 5 on the census date (area *AOBC*) and a life table. However, when the origin moves after the passage of ten years to *O′* (and axes *X′* and *Y′*) the number of children under 5 enumerated in the census would not be area *A′O′B′C′*—the number of children under 5 attributable to the population at the preceding census year—but area *E′O′B′F′* which includes children of immigrants during the past 10 years whether those children were born in the United States or abroad. As a result, the number of births for five years centering on a census date which would be obtained by interpolation would be area *H′IJK′* rather than area *HIJK* and, hence, the estimated number of births in a year centering on the census date would be *LO* rather than *AO* which is the unbiased estimate. Since the relative amount of immigration increased over time before the Civil War, the amount of the upward bias due to this oversight increased over time, and the fall in the true birth rate was somewhat underestimated for this period. After the Civil War, the relative amount of immigration, while fluctuating from a decade to another, tended to decrease and therefore the downward trend of the true birth rate was overstated.

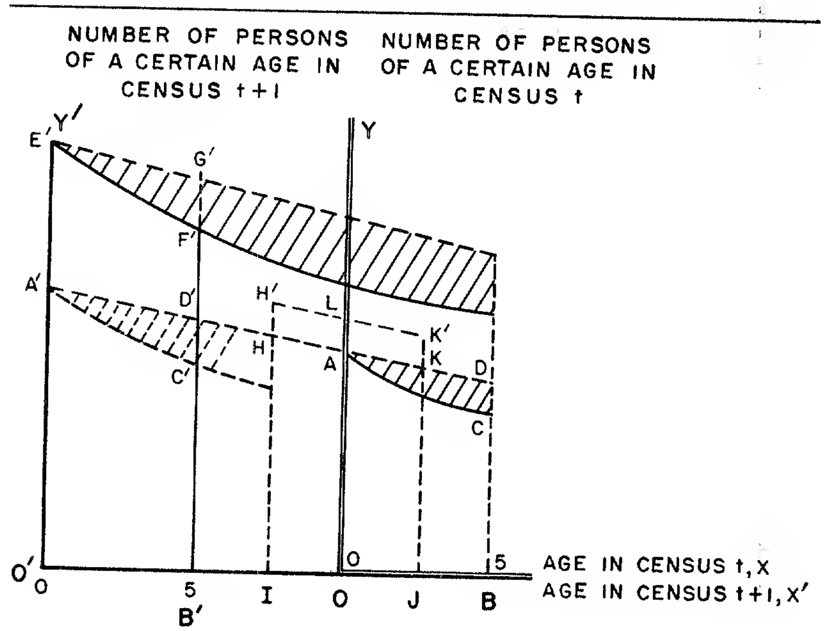

FIGURE 1

Number of Children under 5 Years of Age and Number of Births

The estimate used by most demographers[11] in recent years is a slightly modified version of the Thompson-Whelpton estimate of the ratio of children to women, and it was made by P. K. Whelpton in *Forecasts of the Population of the United States, 1945-1975*.[12] The ratio computed was the number of children under 5 years of age per 1,000 women aged 20 to 44. The number of children was adjusted for underenumeration based on a study for the years 1925 to 1930.[13]

[11] Grabill et al., *op. cit.*, p. 14; Donald J. Bogue, *The Population of the United States*, with a Special Chapter on Fertility by Wilson H. Grabill, Illinois 1959, p. 295; Conrad Taeuber, and Irene B. Taeuber, *The Changing Population of the United States*, New York 1958, p. 251; Paul H. Landis, *Population Problems: A Cultural Interpretation*, 2nd Ed., New York 1954, p. 160.

[12] U. S. Bureau of the Census, *Forecasts of the Population of the United States, 1945-1975*, by P. K. Whelpton, Washington 1947, p. 16.

[13] According to Whelpton: "The number of enumerated white children under 5 in the United States has been increased by 5 percent, and the number of Negro children by 13 percent, these being factors obtained from a study of data for 1925-30." (*Ibid.*, p. 16.) How the amount of underenumeration was estimated was not told. However, judging from the text, the true number of children under 5 years

An innovation introduced by this estimate is the indirect standardization with respect to the age-distribution of women. The method of standardization was explained by Thompson and Whelpton in *Population Statistics, Vol. I, National Data,* as follows: [14]

The ratios are standardized as follows: . . . the following fertility table was applied to the number of women by five-year age periods from 15-19 to 40-44 shown by [each census]; the sum of the births was divided by the sum of the women 20-44 in each census year; these quotients were divided by a quotient obtained in a similar manner for all women 20-44 in the United States in 1930; these second quotients were divided into the ratios [of children to women for each census].

NUMBER OF BIRTHS IN THE UNITED STATES DURING 1925-29 PER 1,000 WOMEN BY AGE ON APRIL 1, 1930
(Estimated from data for the birth registration states)

Age	15-19	20-24	25-29	30-34	35-39	40-44
Births per 1,000 women	52.26	429.74	646.44	555.09	378.46	304.63

The standardized ratio of children to women in census year t can be expressed by the following formula,

$$R^t = \frac{\sum_{i=1}^{6} w_i^t r_i^t}{\sum_{i=2}^{6} w_i^t} \div \frac{\dfrac{\sum_{i=1}^{6} w_i^t r_i^{1930}}{\sum_{i=2}^{6} w_i^t}}{\dfrac{\sum_{i=1}^{6} w_i^{1930} r_i^{1930}}{\sum_{i=2}^{6} w_i^{1930}}}$$

$$= \frac{\sum_{i=1}^{6} w_i^t r_i^t}{\sum_{i=1}^{6} w_i^t r_i^{1930}} \cdot \frac{\sum_{i=1}^{6} w_i^{1930} r_i^{1930}}{\sum_{i=2}^{6} w_i^{1930}}$$

of age was probably estimated by deducting from the estimated number of births during the 5 years ending on the census date the estimated number of deaths of these children which had occurred prior to the census date; the numbers of births and deaths being estimated from the registration returns. Cf. *Ibid.*, pp. 17, 34-35.

[14] U. S. National Resources Committee, *Population Statistics, Vol. I, National Data*, Washington 1937, p. 40.

where R^t is the standardized ratio of children under 5 years of age to women aged 20-44, w the number of women belonging to quinquennial age class i, and r the age-specific fertility rate. $i = 1$ denotes age-class 15-19, $i = 2$ 20-24 and so on.

If we assume that the age-specific fertility rate decreased, or increased for that matter, proportionately in each age-class, we can rewrite the age-specific fertility rate in year t $r_i^t = \alpha^t r_i^{1930}$ and the ratio of children to women

$$R^t = \frac{\alpha^t \sum w^t r^{1930}}{\sum w^t r^{1930}} \cdot \frac{\sum w^{1930} r^{1930}}{\sum w^{1930}}$$

$$= \frac{\sum w^{1930} r^t}{\sum w^{1930}} \qquad \text{(Subscripts are omitted.)}$$

Thus, the standardized ratio of children to women can be interpreted as the number of children under 5 years of age, who would have lived in year t, per 1,000 women aged 20-44 assuming (1) that the age-distribution of women in year t was the same as in 1930 and (2) that the age-specific fertility rate changed proportionately in each age-class between these two dates.

Another way to look at the standardized ratio is to express it as an index number. $\dfrac{R^t}{R^{1930}} = \dfrac{\sum w^t r^t}{\sum w^t r^{1930}}$

This represents the ratio of the actual number of children in year t to the hypothetical one which would result were the 1930 age-specific fertility ratio applied to the age-distribution of women in year t. In this case it is not necessary to assume that the age-specific fetrility rate increased or decreased proportionately in every age-class from a census year to another; but, without this assumption, exact interpretation can be given to the relative values of two numbers only when a comparison is made between 1930 and another census year.

A summary of the estimate for the United States is presented in Table I-3.

All the estimates mentioned above assume that the unknown relative size of a sub-class within an age-class is the same as the comparable ratio given by the nearest census. When we deal with the ratio for the whole nation this assumption of the constancy of age-distribution within an age-class may not be too erroneous, even though the age-distribution has been changing throughout the nineteenth century. However, when we come to think of the

levels and trends of the ratio of children under a certain age to women of child-bearing age for states or smaller units, the change of the age-distribution within a decennial or quinquennial age-class over, say, 40 years may be significant. To cope with this problem, the following method was used in this study.

TABLE I-3

NUMBER[a] OF WHITE CHILDREN UNDER 5 YEARS OF AGE PER 1,000 WHITE WOMEN AGED 20-44: UNITED STATES, 1800-1950

1800	1,342	1880	780
1810	1,358	1890	685
1820	1,295	1900	666
1830	1,145	1910	631
1840	1,085	1920	604
1850	892	1930	506
1860	905	1940	519
1870	814	1950	587

Note: *a.* All numbers except those from 1800 to 1820 have been standardized indirectly to the age-distribution of women in the United States in 1930.

Source: U. S. Bureau of the Census, *op. cit.*, p. 14.

In order to avoid questionable estimation as much as possible, we decided to use, as our basic measures, the number of white children under 10 years of age per 1,000 whites and the number of white children under 10 years of age per 1,000 white women aged 16-44. For the sake of simplicity, the term 'crude birth ratio' will be used for the number of children under 10 years of age per 1,000 population, and the term 'refined birth ratio' for the number of children under 10 years of age per 1,000 women aged 16-44. The number of white children under 10 years of age was given by each census from 1800 to 1860. The number of women aged 16-44 was given by the census of 1800, 1810, and 1820 but for other censuses the numbers of women aged 16-19 and 40-44 had to be estimated.

These numbers were interpolated in the following way. Assuming that the number of women of a certain age decreased arithmetically as we moved from a younger to an older age, we estimated the number of women aged 40-44 first from the reported numbers of women in age-classes, 30-39, and 40-49, and then from the reported numbers of women in age-classes, 40-49, and 50-59. If the numbers of women aged 30-39, 40-49, and 50-59 were in arithmetic progression, the estimate from age-classes

30-39 and 40-49 should coincide with the estimate from age-classes 40-49 and 50-59. Since these three age classes were not normally in arithmetic progression, an arithmetic mean of the two estimates was computed to resolve the conflict. This was our first approximation. It can be expressed as $\frac{A + 8B - C}{16}$, where A, B and C stand for the number of women aged 30-39, 40-49, and 50-59, respectively.[15]

In order to test the performance of this method we selected 10 states arbitrarily and applied our method to the 1870 data. The result of the computation turned out to be a slight underestimation for most states. The errors ranged from .1 to 5.8 per cent but in only three states were they greater than 1.5 per cent. If we adopted Willcox's assumption of the constant proportion of the size of the sub-class (age 40-44) and used the 1890 proportion for estimating the 1870 proportion, the estimates for these ten states would have underestimated the actual proportion by 1.8 to 14.8 per cent. In every one of the ten states, our first approximation gave a better estimate than the one yielded by the assumption of a constant proportion.[16]

A small modification was made on our first approximation to correct its downward bias. First, the United States ratio of the actual to the estimated—by the first approximation—number of women aged 40-44 was computed for 1870 and 1880. Then, the formula for the first approximation was multiplied by the average of the 1870 and 1880 ratios (1.01). Thus, the formula for our second approximation was $1.01\left(\frac{A + 8B - C}{16}\right)$.

[15] If a_1 represents age-class 30-34, a_2 35-39, A 30-39, b_1 40-44, b_2 45-49, and B 40-49, according to the assumption of arithmetic progression

$$a_1 - a_2 = a_2 - b_1 \quad \ldots\ldots (1)$$

also $$a_2 - b_1 = b_1 - b_2 \quad \ldots\ldots (2)$$

From (1) $$a_1 = 2a_2 - b_1 \quad \ldots\ldots (3)$$

From (2) $$b_2 = 2b_1 - a_2 \quad \ldots\ldots (4)$$

But by definition $a_1 = A - a_2$

and $b_2 = B - b_1$.

Substituting into (3) and (4) $$A = 3a_2 - b_1$$
$$B = -a_2 + 3b_1$$

Solving these we get $b_1 = \frac{A + 3B}{8}$

Similarly if c_1, c_2 and C stand for age-classes 50-54, 55-59, and 50-59, we get another estimate of the number of women belonging to the age-class, 40-44 $\frac{5B - C}{8}$

Averaging the two estimates, we get $\frac{A + 8B - C}{16}$.

The number of women aged 16-19 for the censuses between 1830 and 1860 was similarly interpolated. The formula used in this case was $1.03 \left(\frac{-6D + 122E + 2F}{150}\right)$, where D, E, and F stand for the numbers of females aged 10-14, 15-19 and 20-29. The result of the computation for states and territories will be presented and discussed in the next chapter. Here in Table I-4, only the national ratio is shown.

To facilitate comparison, all the series mentioned so far were converted into index numbers with the ratio for the year 1800 as 100. (See Table I-5). All the series show fairly consistent and decided declines. The declines of series *D*, *E*, *F*, and *G* are more consistent than those of series *A*, *B*, and *C*; whereas the former group of series shows decreases for every decade, the latter group shows increases in 1800-1810 and also in 1850-1860. This is because short term fluctuations apparent in series *A*, *B*, and *C* are smoothed out in series *D*, *E*. *F*, and *G* which represent averages for longer time spans. While in series *A*, *B*, and *C* only those surviving children who were born within five years prior to a census date are included, in series *D* and *E* all the surviving children born between a census date and the preceding census date are included. Series *F* and *G* are weighted moving averages involving two adjoining decades.

The trends of these series do not necessarily represent the trend of fertility. First, the degree of underenumeration of children

[16] The result of the test is summarized in the following table.

State or territory	(1) Enumerated number of women aged 40-44, 1870	(2) Our first approximation	(3) Error of the first approximation $\frac{(2)-(1)}{(1)}$	(4) Estimate by the Willcox method	(5) Error of the Willcox estimate $\frac{(4)-(1)}{(1)}$
Massachusetts	45,717	44,523	—2.6%	43,752	—4.3%
Connecticut	15,864	15,792	—0.5	15,409	—2.9
Pennsylvania	87,458	86,315	—1.3	84,739	—3.1
North Carolina	16,811	16,796	—0.1	16,509	—1.8
Georgia	14,530	14,466	—0.4	14,231	—2.1
Wisconsin	26,271	25,901	—1.4	25,578	—2.6
Alabama	11,755	11,765	+0.1	11,289	—4.0
Kansas	6,340	6,291	—0.8	5,754	—9.2
New Mexico	2,099	2,003	—4.6	1,937	—7.7
California	11,392	10,733	—5.8	9,708	—14.8

relative to the underenumeration of population in general or of women of child-bearing age may have changed over time. Some evidence points to the probability of increasingly accurate enumeration [17] and therefore the decline of fertility may be understated by these series. For the period before 1860, however, we have so little information about the amount of underenumeration that corretcion is not feasible. We can only say that the amount of underenumeration of children under 5, or under 10, was probably more than usual in 1850, because, unfamiliar with the new system of recording, some enumerators began the age count with 1 year.[18] The unusually small number of children under 5, or under 10, in 1850 may be partly due to this factor.

Studies for later periods showed that the relative underenumeration of young children was due not so much to a failure to enumerate them at all when their parents were counted but to misstatements of age, especially to a tendency to report the age of children in terms of an approaching birthday.[19] If this was also true of earlier censuses—and there is no reason to think that it was not—the enumerated number of children aged 5-9 must have been more accurate than the enumerated number of children under 5. Therefore, the relative amount of underenumeration, and fluctuations in it over time, are likely to have been smaller in Series *D* and *E* than in Series *A*, *B*, and *C*.

Secondly, the mortality of children may have changed. It is quite probable that it declined after the middle of the nineteenth century. Therefore, we can say that the decline of fertility since, say, 1860 is probably understated by the ratio-of-children-to-women series. However, child mortality may have increased during the first half of the century. If so, the declining trends of the ratios of children to women overstate the change in fertility. This question is examined in Chapter III. Here only this much can be said that the effect of changing mortality is bound to be felt to a greater extent in Series *D* and *E* which use the number of children under 10 than in other series using the number of children under 5.

Thirdly, the rate of increase of yearly births attributable to a

[17] Thompson and Whelpton, *op. cit.*, p. 264.

[18] Grabill et al., *op. cit.*, p. 409.

[19] *Ibid.*, pp. 406-413; Robert J. Myers, "Errors and Bias in the Reporting of Ages in Census Data," *Transactions of the Actuarial Society of America*, October 1940, 41, pp. 395-397.

TABLE I-4

CRUDE AND REFINED BIRTH RATIOS FOR THE WHITE POPULATION, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITES, AND PER 1,000 WHITE WOMEN AGED 16-44: UNITED STATES, 1800-1860

	Crude birth ratio	Refined birth ratio
1800	346	1,844
1810	344	1,824
1820	334	1,735
1830	325	1,586
1840	316	1,514
1850	286	1,335
1860	284	1,308

Source: U. S. Censuses. Cf. Appendix III.

TABLE I-5

COMPARISON OF DIFFERENT ESTIMATES OF FERTILITY TRENDS: UNITED STATES, 1800-1950 (1800 = 100)

SERIES:	*A* Number of children 0-4 per 1,000 women 16-44	*B* Number of white children 0-4 per 1,000 white women 15-44	*C* Number[a] of white children 0-4 per 1,000 white women 20-44	*D* Number of white children 0-9 per 1,000 white women 16-44	*E* Number of white children 0-9 per 1,000 whites	*F* Crude birth rate for whites	*G* Refined birth rate for whites
ESTIMATOR:	Willcox	Thompson & Whelpton	Whelpton	Present estimate	Present estimate	Thompson & Whelpton	Thompson & Whelpton
1800	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1810	100.0	100.1	101.2	98.8	99.4	98.7	98.6
1820	95.1	95.1	96.5	94.1	96.5	96.0	93.5
1830	89.9	87.7	85.3	86.0	93.9	93.4	86.3
1840	85.6	83.7	80.8	82.1	91.3	87.8	79.9
1850	71.6	69.2	66.5	72.4	82.7	78.7	69.8
1860	73.2	70.9	67.4	70.9	82.1	75.3	66.0
1870	66.5	64.1	60.7			69.6	60.1
1880	65.1	61.6	58.1			64.0	56.5
1890	56.8	54.3	51.0			57.3	49.3
1900	55.4	53.4	49.6			54.7	46.8
1910		50.8	47.0			49.8	42.1
1920		49.5	45.0			47.5	40.6
1930		40.5	37.7			36.5	31.3
1940			31.2				
1950			43.7				

Note: *a*. All numbers except those from 1800 to 1820 have been standardized indirectly to the age-distribution of women in the United States in 1930.

Source: *A*, Table I-1; *B*, *F*, and *G*, Table I-2; *C*, Table I-3; *D* and *E*, Table I-4.

cohort of population which resided, or would have resided if alive, in the United States at a census date[20] most certainly decreased. *Caeteris paribus,* the proportion of children under 1 among children under 5, or under 10, would have been smaller in a later year, and, therefore, the decline of fertility is likely to be even greater than is shown by the number of children under 5, or under 10, per 1,000 women. Thompson and Whelpton tried but failed to remove this bias because, as we have said before, they neglected the effect of immigration. An effort to take this factor into account will be made in Chapter III.

Finally, the effect of the changing age and sex distributions of population is to some extent taken into account in Series *A*, *B*, *C*, *D*, and *F*, which used the number of women of child-bearing age as a denominator. The slower declines of the numbers of children per 1,000 population than the number of children per 1,000 women of child-bearing age reflect the increase of the proportion of these women among the total population.

The indirect standardization in Series *C* is an effort to take account of the change in the age-distribution of women within child-bearing ages. It should be noted that the portion of the series representing 1800-1820 is not comparable with the portion for 1830 and later, because only the latter is standardized. The unusually large drop between 1820 and 1830 is quite misleading.

2. *Estimates from the Rate of Natural Increase of Population and the Death Rate*

If we know the number of the total population for two dates, the number of net immigrants and the number of deaths between the same dates, it is possible to estimate the number of births by subtracting from the increment of population the number of net immigrants and then adding the number of deaths.

[20] If population was closed, "the rate of increase of yearly births" without qualification could have been used. As it was not, a rather clumsy qualifying phrase had to be attached. If "the rate of increase of yearly births attributable to a cohort of population which resided, or would have resided if alive, in the United States at a census date" is r, the number of children aged x at the census date C_x, the number of survivors aged x in a life-table population L_x and the number of yearly births in a life-table population l_0, the number of births in the census year (B) can be computed from the number of children aged n or younger ($\sum_{x=0}^{n} C_x$) at the census date according to the following formula, $B = \dfrac{l_0 \sum_{x=0}^{n} C_x}{\sum_{x=0}^{n} L_x(1+r)^{-x}}$.

Samuel Blodget, in the beginning of the nineteenth century, apparently used this method to estimate the number of annual births.[21] According to Wilson H. Grabill's reasoning, Blodget arrived at his estimate of the birth rate in the following way. First, the annual rate of growth of total population was computed from the censuses of 1790 and 1800, and, by applying this ratio, an estimate of population in each year between 1790 and 1805 was obtained. Then, net immigration was estimated from port records and this was subtracted from the annual increase of population. Finally, total yearly deaths, estimated from bills of mortality of various towns and held to be constant at 25 per 1,000, were added to the natural increase of population. The annual birth rates thus computed ranged between 52 and 53 per 1,000 between 1790 and 1805.

This was an interesting exercise in estimating the birth rate at an early period, but the estimates of immigration and deaths were based on such unreliable data that much trust cannot be placed in the result.

Alfred J. Lotka's estimate of the crude birth rate for 1790 is based on a variant of this method.[22] The rate of natural increase of population was computed from the census figures for 1790 and 1800 and from the estimate of net immigration based on the study of Clinton Stoddard Burr.[23] The annual rate of increase of population was .0301 and the rate of natural increase was estimated at .0287.

In order to arrive at the number of deaths, Lotka chose to use the English Life Table for 1838-54. If the age-distribution of the population in 1790 were available, he could have applied the Life Table death rates to it to obtain the number of deaths. But the population was not classified into detailed enough age-groups in 1790 nor in any of the three subsequent censuses to allow the application of age-specific death rates.

Lotka, therefore, decided to introduce the theory of stationary age-distribution to solve this problem indirectly. First, he accepted

[21] Samuel Blodget, *Economica: A Statistical Manual for the United States of America*, Washington 1806, p. 58; cf. Grabill's essay in Bogue, *op. cit.*, p. 292.

[22] Alfred J. Lotka, "The Size of American Families in the Eighteenth Century and the Significance of the Empirical Constants in the Pearl-Reed Law of Population Growth," *Journal of the American Statistical Association*, June 1927, New Series 22, pp. 155, 158-159, 165.

[23] Clinton Stoddard Burr, *America's Race Heritage*, New York 1922, pp. 272-275.

the Pearl-and-Reed Law as adequately describing the growth of population in the United States. In an early stage of the Pearl-and-Reed growth, population increases roughly in geometric progression. If migration was negligible, this means that the " normal or stationary " age-distribution is attained, based on stationary age-specific death rate and birth rate.

Once this premise is accepted, the age-distribution and, then, the crude birth rate can be computed from

$$c(a) = be^{-ra}p(a)$$

where $c(a)$ is the proportion of population aged a among total population, b the crude birth rate, r the rate of natural growth of population and $p(a)$ the probability of surviving until age a.[24] Since

$$\int_0^\infty c(a)\,da = 1,$$

$$b = \frac{1}{\int_0^\infty e^{-ra}p(a)\,da}.$$

Solving this, Lotka obtained a crude birth rate of 50.8 per 1,000.

Although this estimate is more sophisticated than Blodget's, we again have to allow for the possibility of a large error. First, in as early a period as 1790-1800, the record of immigration was very inadequate. Even the statistics of third-class passengers arriving at the United States ports are available only after 1820 and there is no way of knowing the amount of return and overland migration. The estimates of net migration by different writers varied greatly: for example, Blodget's estimate for 1790-1799 was a mere 39,300 [25] while Seaman's estimate was as high as 195,849.[26] Most writers of today do not dare to hazard a guess.

Another source of error is in the estimate of age-distribution. To some extent we can test Lotka's premise by computing, according to his method, the number of people belonging to the age-classes of the 1800 census. The result of such computation is shown in Table I-6 compared with the actual age-distribution in 1800.

[24] Cf. Alfred J. Lotka, " The Stability of the Normal Age Distribution," *Proceedings of the National Academy of Sciences*, November 15, 1922, 8, pp. 339-345.

[25] Blodget, *op. cit.*, p. 58.

[26] Seaman, *op. cit.*, p. 365.

Lotka's theoretical age-distribution overestimated the proportion of the population belonging to the age-class 0-9, at the expense of three age-classes between ages 10 and 44. Since the death rate was much higher in the age-class 0-9 than in the age-class 10-44, Lotka's estimate, as far as the error in the estimate of age-distribution is concerned, overstated the crude death rate, and, hence, overstated the crude birth rate too.

TABLE I-6

THEORETICAL AND ACTUAL AGE-DISTRIBUTIONS OF POPULATION: UNITED STATES, 1800

Age	Lotka's theoretical age distribution	Age distribution as reported in the census	Actual age distribution corrected for underreporting of young children [a]
0–9	37.9%	34.0%	34.6%
10–15	14.0	15.4	15.3
16–25	17.6	19.2	19.0
26–44	18.3	19.3	19.1
45 and up	12.3	12.1	12.0
All ages	100.1	100.0	100.0

Note: *a*. First, the number of children under 5 years of age was estimated on the assumption that the proportion of children under 5 among children under 10 in 1800 is the same as the corresponding proportion in 1830 (55.3%). Then, the estimated number of children under 5 years of age was increased by 5% to allow for the relative underreporting of children in this age-class.

Source: Actual age-distribution, U. S. Census. Cf. Appendix III.

Lastly, the use of the English Life Table 1838-54 may be questioned. The mortality rate in the United States seems to have been lower than in England during the first half of the nineteenth century.[27] If mortality rates decreased in the United States between 1790-1800 and 1838-54, the difference in mortality levels of the two countries may be offset by difference in time. But, as we shall see in Chapter III, it is rather unlikely that there was a noticeable decrease in mortality in this period and hence the birth rate may have been overestimated on this account as well.

Presumably, we can apply the same method for a later period. The estimate would certainly be more reliable for 1830 and after-

[27] Blodget, *op. cit.*, pp. 96-97; A. J. Jaffe, and W. I. Lourie, Jr., "An Abridged Life Table for the White Population of the United States in 1830," *Human Biology*, September 1942, 14, p. 363.

ward, for the population was classified into more detailed age-groups and there were more reliable life tables. However, this method is decidedly inferior to the one using the ratio of children to women of child-bearing age. First, the statistics of net immigration, which are essential only in the former method, were not reliable for the period before the Civil War. Secondly, no reliable death statistics are available for the period and, while the deaths at all ages affect the outcome of the method using the rate of natural increase, only the deaths of children who would have been 0-4 (or 0-9) years old at a census date figure [28] in the result of the ratio-of-children-to-women method. Thirdly, due to the lack of statistics of interstate migration and of state mortality rates the birth rate can not be estimated for different states by this method. For these reasons, in the later chapters of this study, no use is made of the method using the rate of natural increase and the death rate.

3. *Estimates from Genealogies and College Alumni Records*

A third method of estimating the levels and trends of fertility is to use genealogies and college alumni records.

In 1903 Edward Thorndike published an interesting article in the *Popular Science Monthly* discussing the decrease in the size of families of graduates from three north-eastern colleges.[29] The colleges included were Middlebury College, Wesleyan College and New York University.

In the case of Middlebury College and New York University alumni catalogues were utilized and the numbers of all children, living and dead, of husbands who had been married at least ten years were tabulated. In the case of Wesleyan, data were collected from two sources, namely, answers to a questionnaire collected by a professor and the report of a president. Unfortunately, the former source counted all the children, dead and living, while the latter counted the living children alone. The distribution of graduates for the two sources was not shown. In both cases, the children of all married graduates were included.

[28] The death rate for women aged 15-49 also matters if we choose, as we shall in Chapter III, to estimate the rate of increase of yearly births from the rate of increase of women of child-bearing age.

[29] Edward Thorndike, "The Decrease in the Size of American Families," *The Popular Science Monthly*, May 1903, 63, pp. 64-70.

In the same year, G. Stanley Hall and Theodate L. Smith published a study which covered a longer period and more colleges.[30] For Harvard, oldest of the colleges, the study went back to 1658; and twelve colleges were included altogether. They were Harvard, Yale, Amherst, Wesleyan, Middlebury, Bowdoin, Brown, Dartmouth, Williams, Vassar, Smith, and Wellesley. The reports on the last seven, however, referred to graduates after 1860 only and, therefore, our discussion will be limited to the first five. Anyway, comparability of average number of children is doubtful for the graduates after 1865 or so, since a sizable number of wives must have been younger than 50 years of age at the time of the survey.

Except for the very early periods of Harvard and Yale, data were collected from class secretaries and from published class reports. The record of Harvard for 1658-1690 was compiled from John Langdon Sibley's *Biographical Sketches of Harvard*, published in 1885, and the information about the first sixty-three years of Yale was obtained from J. Franklin Dexter's *Yale Annals Biographies.*

Hall and Smith computed only the average number of children 'who lived to maturity' per graduate and/or per married graduate but sometimes the total number of children 'who died before maturity' was also given. In such cases, the average number of children who were born per graduate was computed.

While these two studies dealt only with male graduates from colleges,[31] a study by Amy Hewes of Mount Holyoke graduates cast some light on the change in the average number of children of an educated woman.[32] Her data were based on answers to a questionnaire sent out in 1910 to the living graduates of Mount Holyoke Seminary. The experience of the alumnae of Mount Holyoke College was also analysed by Hewes but, since the first students did not graduate until 1889, reference to this part of the study is omitted in this chapter.

The Seminary study included graduates from 1842 through

[30] G. Stanley Hall and Theodate L. Smith, "Marriage and Fecundity of College Men and Women," *The Pedagogical Seminary*, September 1903, 10, pp. 275-314.

[31] It is true that the Hall and Smith study dealt with the experience of graduates of several women's colleges but the average number of children per graduate is of little value, since most women graduates were still in child-bearing age at the time of the investigation.

[32] Amy Hewes, "Marital and Occupational Statistics of Graduates of Mount Holyoke College," *Publications of the American Statistical Association*, December 1911, 12, pp. 771-797.

1892.[33] All the children born were counted. Since a questionnaire was sent only to living graduates in 1910 the fertility data for those who graduated before 1880 can be interpreted as representing completed fertility.

Finally, there are two studies of genealogical records, one by George J. Engelmann and the other by Carl E. Jones. Engelmann's study [34] included 2,038 married women in New England who lived between 1600 and 1850. Only those children who reached maturity were counted. How these women were classified into different periods, namely whether by date of birth, or of marriage, or of death, was not explained.

Jones's data were taken from five genealogies each furnishing approximately 4,000 individuals.[35] Where these individuals lived was not stated. The average number of children born per married couple was shown. The whole period 1651-1900 was divided into five 50-year periods and it was alleged that "the children listed in each fifty-year period are those born within the period in question." [36] What was done in case children from the same parents were born in different 50-year periods was not told. Nor was the way remarriages were treated explained.

The results of these studies are tabulated in Table I-7. All the series, except the Mount Holyoke one, show similar trends. The average number of children did not show any consistent change until the latter half of the eighteenth century when decidedly downward trends set in to continue throughout the period covered by these series. The fall in the average number of surviving children per graduate was as large as 67.4% for Harvard graduates between 1680-1690 and 1860-1869, or 59.6% for Yale graduates between 1705-1714 and 1861-1879.

The average number of children per graduate decreased faster than the average number of children per married graduate in all series except that for Wesleyan graduates, reflecting the fact that the proportion of college graduates who were eventually married decreased over time. For example, the average number of surviving children per Harvard graduate decreased 54.9% between

[33] *Ibid.*, p. 772.

[34] George J. Engelmann, "The Increasing Sterility of American Women," *The Journal of the American Medical Association*, October 1901, 37, pp. 891, 893.

[35] Carl E. Jones, "A Genealogical Study of Population," *Publications of the American Statistical Association*, December 1918, 16, pp. 201-209, 219.

[36] *Ibid.*, p. 209.

1658-1667 and 1870-1879 while the average number of surviving children per married Harvard graduate decreased only 45.3%. The corresponding rates of decrease for Yale graduates between 1705-1714 and 1861-1879 were 59.6% and 51.7%, respectively.

No consistent differences in the average number of children seems to have existed among graduates from different colleges. However, throughout the whole period, the average number of children per married woman in the genealogies, particularly in those used by Engelmann, tended to be larger than the number of children per married college graduate.

Caution is needed in interpreting these figures. First, the groups represented are very special ones and it is not appropriate to draw inference from them to Americans in general. The groups represented in the college graduates series were among the best educated men and women in each period. Who were included in the genealogies is not clear, but it is likely that most individuals were of the higher social classes.

Secondly, sometimes only the surviving children were counted. If the death rate of children changed over time, the average number of surviving children is misleading as an index of fertility as such, although it serves a useful purpose as a measure of what might be called effective fertility. Though there is some doubt about the first half of the nineteenth century, the general trend of the death rate of children is believed to have been downward. Therefore, fertility must have declined more than the average numbers of surviving children show. This was what actually happened in the Yale series except from the first period (1705-1714) to the second (1715-1724). The death rate in the Harvard series apparently increased during the seventeenth century but it was generally higher than the death rates in the Yale series in the eighteenth century. (Cf. Table I-8)

Thirdly, either a husband or his wife might have died before the completion of the wife's child-bearing life. The average number of surviving children born per graduate, married and non-married, may be interpreted as an index of the reproductivity of a class of people corresponding to the net reproduction rate. However, this is not an index of fertility as such and its trend does not tell the trend of fertility if the death rate has changed. If the death rate decreased over time, the actual fall of fertility was greater than that shown by the average number of children per graduate. The Thorndike series of Middlebury College and

TABLE I-7

AVERAGE NUMBER OF CHILDREN PER MARRIED COUPLE AND PER COLLEGE GRADUATE: 1600-1900

A. Per Married Couple						
Series:	New England women	Five genealogies	Harvard		Yale	
Compiler:	Engelmann	Jones	Hall & Smith		Hall & Smith	
Children included:	Surviving	All children born	All children born	Surviving	All children born	Surviving
Year *						
1600–1650	6.7					
1658–1667			4.18	3.56		
1668–1679	6.1[a]	5.8[b]	5.62	4.46		
1680–1690			6.00	4.56		
1705–1714					5.63	5.28
1715–1724					4.91	4.12
1725–1734	6.6[c]	5.9[d]			5.54	4.82
1735–1744					5.55	4.87
1745–1754					5.09	4.50
1752–1762					5.02	4.43
1755–1765	6.1[e]	6.1[f]				4.04
1810–1841						4.13
1840–1849	4.6[g]	4.8[h]				
1841–1861						3.35
1860–1869				2.22		2.55[i]
1870–1879		3.0[j]		1.93	1.83[k]	1.65[k]
B. Per College Graduate						
1658–1667			3.72	3.17		
1668–1679			4.92	3.89		
1680–1690			5.79	4.39		
1705–1714					5.37	5.05
1715–1724					4.67	3.91
1725–1734					5.10	4.44
1735–1744					5.18	4.55
1745–1754					4.75	4.20
1752–1762					4.29	4.07
1755–1765						3.80
1810–1841						4.13
1841–1861						2.68
1860–1869				1.62		1.99[i]
1870–1879				1.43	1.24[k]	1.12[k]

TABLE I-7 (Continued)

A. Per Married Couple

Series:	Amherst	Wesleyan	Wesleyan	N. Y. U.[l]	Middlebury		Mount Holyoke[m]
Compiler:	Hall & Smith	Hall & Smith	Thorndike	Thorndike	Hall & Smith	Thorndike	Hewes
Children included:	All children born	All children born	not clear	All children born	All children born	All children born	All children born
Year *							
1803–1809						5.6	
1810–1819						4.8	
1820–1829	3.49[n]					4.1	
1830–1839	3.61	4.48[o]	4.5	4.0[p]		3.9	
1840–1849	3.24	3.52	3.3	3.2[q]	3.39[r]	3.4	2.77[s]
1850–1859	3.98[t]	3.28	3.2	2.9[u]	2.83	2.9	3.38
1860–1869		2.83	2.6	2.5[v]	2.81	2.8	2.64
1870–1879	1.59[w]	3.30[x]			1.91[y]	2.3[z]	2.75
1875–1879						1.8	

B. Per College Graduate

1825–1829	3.33						
1830–1839	3.27	3.69					
1840–1849	2.79	2.87			2.93[r]		
1850–1859	3.02[t]	2.92			2.66		
1860–1869		2.54			2.66		
1872–1878	1.43	2.71[x]			1.58[y]		

Note: *a.* 1650-1700; *b.* 1651-1700; *c.* 1700-1750; *d.* 1701-1750; *e.* 1750-1800; *f.* 1751-1800; *g.* 1800-1850; *h.* 1801-1850; *i.* 1861-1879; *j.* 1851-1900; *k.* 1872-1881; *l.* Only for those marriages which lasted at least ten years; *m.* Only for those graduates living in 1910; *n.* 1825-1829; *o.* 1833-1839; *p.* 1835-1844; *q.* 1845-1855; *r.* 1844-1849; *s.* 1842-1849; *t.* 1850-1851; *u.* 1855-1864; *v.* 1865-1874; *w.* 1872-1878; *x.* 1870; *y.* 1870-1878; *z.* 1870-1874; * Year means the year of graduation in the case of college graduate. What the period exactly means is not clear in the case of genealogies. In Engelmann's series it is supposed to be the period in which women classified into that period lived. In Jones's series, it is claimed to be the period in which children counted were born.

Source: New England women. Engelmann, *loc. cit.*, p. 893; Five genealogies, Jones, *loc. cit.*, p. 209; Harvard, Hall and Smith, *loc. cit.*, pp. 290-291, 298; Yale, *ibid.*, pp. 286-288, 298; Amherst, *ibid.*, p. 294; Wesleyan, *ibid.*, p. 297, Thorndike, *loc. cit.*, p. 64; New York University, *ibid.*, p. 64; Middlebury, *ibid.*, p. 64, and Hall and Smith, *loc. cit.*, p. 296; Mt. Holyoke, Hewes, *loc. cit.*, p. 779.

New York University eliminate this difficulty partially. The Hewes series of Mount Holyoke is the only one free from the difficulty.

The Hewes series may nevertheless be misleading as a measure of the completed fertility, if there was selectivity in the probability of survival depending upon the fecundity or fertility of a woman. If a stronger woman tended to have more children and also to live

longer, any downward trend of the completed fertility based on a survey of living women at a point of time must be discounted. If, however, a less fertile woman tended to live longer because of less exposure to the risk of death at child-birth or because of less exhaustion, the contrary can be said.

TABLE I-8

PROPORTION OF CHILDREN WHO DIED BEFORE MATURITY AMONG TOTAL CHILDREN BORN OF HARVARD AND YALE GRADUATES: 1658–1881

College	Year	
Harvard	1658–1667	14.7%
	1668–1679	20.8
	1680–1690	24.0
Yale	1705–1714	6.5
	1715–1724	16.2
	1725–1734	13.0
	1735–1744	12.3
	1745–1754	11.6
	1752–1762	11.8
	1872–1881	9.9[a]

Note: *a.* The ratio may have a considerable downward bias, because many children may not have reached maturity at the time of investigation.

Source: Hall and Smith, *loc. cit.*, pp. 286-288, 290-291, 298.

Finally, the accuracy of the statistics may be doubted. We have seen that even the number of living children enumerated through direct interviews by census-takers were not without errors. It would be naive to believe that inexperienced class secretaries could record the correct numbers of children, living and dead, through correspondences. The absolute numbers of children, particularly those who died before maturity, per family probably should not be relied upon. Neither should the difference between the average numbers of children of college graduates and those of the women in the genealogies. However, there is no reason to believe that the degree of underenumeration should have increased with time, and, therefore, the general downward trends of most of the series may be interpreted as indicating the actual trend in fertility.

4. Registration of Births in Several States

A fourth method of estimating fertility is to use the records of annual births kept by several states, mostly in New England.

Massachusetts took a lead in the modern system of registration of births in 1841. Connecticut, Rhode Island and Vermont soon followed suit and by 1860 nine states had a registration law.[37] However, the registration was quite inaccurate in early years and only through the most thorough study of the extent of under-registration, such as the one on Massachusetts by Gutman,[38] can the real level and trend of the birth rate be estimated. Gutman's estimate of the real birth rate is shown below along with the

TABLE I-9

CORRECTED AND UNCORRECTED CRUDE BIRTH RATES, MASSACHUSETTS, 1844-1861

Year	Registered birth rate	Corrected birth rate
1844–46	18.2	35.1
1849–51	27.5	33.2
1854–56	29.2	34.5
1859–61	29.0	33.2

Source: Gutman, *loc. cit.*, p. 78.

uncorrected data. Uncorrected birth rates in other states seem to be of little value for the period before 1860 and, therefore, are ignored.

5. *Summary*

In this chapter four different methods of estimating the levels and trends of fertility have been examined. Two of them—estimating from the rate of natural growth of population and the death rate, and estimating from the number of registered births in several states—were judged to be of little value for the period 1800-1860 due to the unreliability of the data available. Another estimating from genealogies and college alumni records, is intrinsically biased but may be useful for estimating the fertility trend of a portion of the population from which samples were taken. Only one of the four methods, estimating from the census statistics of population by age, is reasonably reliable. It is also the most useful, because according to this method, (1) the fertility of all

[37] S. Shapiro, "Development of Birth Registration and Birth Statistics in the United States," *Population Studies*, June 1950, 4, p. 87; Thompson and Whelpton, *op. cit.*, p. 262.

[38] Robert Gutman, "The Birth Statistics of Massachusetts during the Nineteenth Century," *Population Stuides*, July 1956, 10, pp. 69-94.

the persons in the United States is represented and (2) the fertility ratio can be computed by geographical division. Therefore, in ensuing chapters we shall mostly use this method to analyse the levels and trends of fertility in the United States in the period 1800-1860.

Estimates from the census statistics of population, genealogies, and college alumni records showed that the fertility of American women probably started to fall some time towards the end of the eighteenth century and continued to decline steadily throughout the nineteenth century. The ratio of children under 10 years of age to women aged 16-44 decreased 29.1% between 1800 and 1860. The average number of children " surviving to maturity " per married New England woman decreased 24.6% between 1750-1800 and 1800-1850. As large, or larger, declines took place in the average number of children per college graduate. The rate of decrease of the average number of children per married graduate from Middlebury College between 1803-09 and 1860-69 was as large as 50.0%. The average number of surviving children per Harvard graduate decreased 43.9% between 1680-90 and 1860-69, while the comparable number for Yale graduates decreased 45.7% between 1705-14 and 1841-61.

These trends were affected by factors other than fertility, such as the accuracy of records, mortality, the age-distribution of women, and the rate of increase of population. However, many of these factors tended to increase the ratio of children to women or the average number of children per family over time, and it seems unlikely that a major part of the fall in the ratio of children to women, or in the average number of children per family, can be explained by them. In order to confirm this observation, we shall examine the trend of some of these factors in later chapters.

CHAPTER II

BIRTH RATIOS OF THE WHITE POPULATION OF STATES AND TERRITORIES, 1800-1860

In this chapter, the method which was used in the last chapter to estimate the crude and refined birth ratios is applied to the population statistics of states and territories[1] so that we can learn about the geographical differentials in the birth ratios and the trends of the birth ratios in different states.

1. *Differentials in the Crude Birth Ratios of the White Population of States and Territories*

Geographical differentials in the birth rates or birth ratios, which have been observed by many demographers for different periods and different countries, show up on the state level throughout the period under consideration. (See Table II-1.) As early as 1800, the white crude birth ratio, or the number of white children aged 0-9 per 1,000 white population, ranged from the low of 298 for Rhode Island to the high of 411 for Tennessee, the ratios for other states scattering between the two without any noticeable clustering. A similarly wide spread of ratios is seen for every subsequent census year.

To see the relative positions of states, states were ranked in the order of their crude birth ratios (Table II-2). In general, older states tended to have lower crude birth ratios than newer states. In 1800, new states such as Vermont, Kentucky, and Tennessee and territories like Indiana, Mississippi, and the Territory Northwest of the River Ohio were at the top of the array followed by the South Atlantic and the Middle Atlantic states

[1] Until 1820 Maine was a part of the state of Massachusetts. However, in the censuses of 1800 and 1810 it was treated as an independent district along with other states and territories. This practice will be followed in this study.

TABLE II-1

WHITE CRUDE BIRTH RATIO
NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITES, BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	364	353	322	309	297	258	242
New Hampshire	331	312	288	269	248	212	207
Vermont	375	344	302	290	275	241	231
Massachusetts	299	292	272	250	237	218	228
Rhode Island	298	291	283	265	240	226	223
Connecticut	301	289	270	249	237	215	223
Middle Atlantic							
New York	350	353	329	310	286	253	256
New Jersey	342	326	318	302	294	270	267
Pennsylvania	346	344	336	320	313	288	286
South Atlantic							
Delaware	319	337	321	304	299	284	277
Maryland	322	318	311	289	293	275	274
Virginia	349[b]	342[b]	331[b]	331[b]	324[b]	298	296
North Carolina	362	355	349	340	335	300	292
South Carolina	367	360	348	342	334	299	285
Georgia	374[a]	373	362	372	369	331	310
Florida				344	301	323	305
East North Central							
Ohio	400[ae]	397[b]	378[b]	359[b]	339	304	291
Indiana	359[a]	397[b]	393	393	350	330	313
Illinois		373[a]	374	393	350	321	306
Michigan		312[a]	274[a]	324[a]	326	301	278
Wisconsin					281[a]	307	320
East South Central							
Kentucky	402	388	370	358	347	319	310
Tennessee	411	400	386	380	366	324	307
Alabama			385	391	375	326	314
Mississippi	377[a]	359[a]	363	369	364	336	307
West North Central							
Minnesota						271[a]	333
Iowa					339[a]	340	330
Missouri		386[ad]	365[a]	390[a]	363	323	314
Dakota							229
Nebraska							286
Kansas							307
West South Central							
Arkansas			363[a]	379	374	347	336
Louisiana		327[ac]	312	317	307	275	285
Texas						326	325

State or territory	1800	1810	1820	1830	1840	1850	1860
Mountain							
Colorado							23
New Mexico						285[a]	300
Utah						302[a]	287
Nevada							71
Pacific							
Washington							209
Oregon						297[a]	328
California						43	200
U. S.	346	344	334	325	316	286	284

Note: *a.* These figures are not comparable with later figures because of territorial changes. *b.* Strictly speaking, these figures are not comparable with later figures for the same reason. But the territorial changes involved are rather minor in these cases and are disregarded in the analysis in the text. *c.* Orleans Territory. *d.* Louisiana Territory. *e.* The Territory Northwest of the River Ohio.

Source: U. S. Censuses. Cf. Appendix III.

TABLE II-2

RANKS OF STATES AND TERRITORIES WITH RESPECT TO THE WHITE CRUDE BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITES: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	8	11	16	19	20	28	31
New Hampshire	15	20	22	25	26	34	38
Vermont	5	13	21	21	25	30	32
Massachusetts	19	22	25	26	28	32	34
Rhode Island	20	23	23	25	27	31	36
Connecticut	18	24	26	27	29	33	35
Middle Atlantic							
New York	11	12	15	18	23	29	30
New Jersey	14	18	18	22	21	27	29
Pennsylvania	13	14	13	16	16	21	23
South Atlantic							
Delaware	17	16	17	20	19	23	27
Maryland	16	19	20	23	22	25	28
Virginia	12[b]	15[b]	14[b]	14[b]	15[b]	19	18
North Carolina	9	10	11	13	12	17	19
South Carolina	7	8	12	12	13	18	24
Georgia	6[a]	6	10	7	3	4	10
Florida				11	18	9	16

State or territory	1800	1810	1820	1830	1840	1850	1860
East North Central							
Ohio	3[ae]	2[b]	4[b]	9[b]	11	14	20
Indiana	10[a]	3[b]	1	2	8	5	9
Illinois		7[a]	5	1	7	11	15
Michigan		21[a]	24[a]	15[a]	14	16	26
Wisconsin					24[a]	13	6
East South Central							
Kentucky	2	4	6	10	9	12	11
Tennessee	1	1	2	5	4	8	14
Alabama			3	3	1	6	7
Mississippi	4[a]	9[a]	9	8	5	3	12
West North Central							
Minnesota						26[a]	2
Iowa					10[a]	2	3
Missouri		5[ad]	7[a]	4[a]	6	10	8
Dakota							33
Nebraska							22
Kansas							13
West South Central							
Arkansas			8[a]	6	2	1	1
Louisiana		7[ac]	19	17	17	24	25
Texas						7	5
Mountain							
Colorado							42
New Mexico						22[a]	17
Utah						15[a]	21
Nevada							41
Pacific							
Washington							37
Oregon						20[a]	4
California						35	40

Note: *A higher rank means a higher birth ratio.* *a.* The crude birth ratio of the state in this census year is not comparable with that in later years because of territorial changes. *b.* These states also underwent territorial changes but the changes were so minor as to be neglected in their effect on the crude birth ratios. *c.* Orleans Territory. *d.* Louisiana Territory. *e.* The Territory Northwest of the River Ohio.

Source: Table II-1.

in that order. The older New England states were at the bottom of the array.

With the creation of new territories—since these usually took their place at the top of the array—the relative positions of the older states among all the states became lower, but the standings

of the older states relative to each other remained largely the same. Thus, in 1860, all but four of the sixteen 'original states'[2] had crude birth ratios below the median and all the sixteen were included in the lower three-fourths. Among these older states, the states in New England still remained at the bottom with the Middle Atlantic states in the intermediate positions and the South Atlantic states at the top. Newer states and territories in the West, with few exception, showed the highest crude birth ratios. Within a census division, states which were settled earlier than other states, such as Ohio in the East North Central, Kentucky in the East South Central, and Louisiana in the West South Central, occupied relatively low ranks in their respective region. This systematic pattern is disturbed by some unusually and temporarily low crude birth ratios in sparsely populated areas such as Indiana in 1800, Michigan in 1810 and 1820, Wisconsin in 1840, California in 1850 and 1860, Nevada and Colorado in 1860. If territories are excluded from the ranking, the systematic pattern will become clearer.

Another characteristic of the geographical pattern of the crude birth ratios is the North-South differential. The crude birth ratios tended to be lower in the northern states than in the southern states. The lower average ratio for the New England states than for the South Atlantic states has already been mentioned (See Table II-3 for the crude birth ratio by census division). Simple comparison of this sort does not give a neat result for western states due to the fact that the southern states were settled earlier than the northern states having a comparable east-west position. However, when two states with approximately the same year of admission into the Union are compared, it is found that the northern state tended to have a lower birth ratio than the southern state. For example, if we pair states in the order of their admission into the Union, we get such North-South combinations as Tennessee and Vermont, Kentucky and Ohio, Louisiana and Indiana, Mississippi and Illinois, Alabama and Maine, Missouri and Arkansas, Michigan and Texas, and Florida and Iowa. In 1850 and 1860 all but two of the pairs (Louisiana and Indiana, and Florida and Iowa[3]) conform to the North-South thesis.

It has been observed that since the Civil War geographical

[2] The states whose boundaries in 1860 were approximately the same as in 1800. These include all the states in 1800 except Georgia.

[3] Florida and Iowa are tied in 1850.

TABLE II-3

WHITE CRUDE BIRTH RATIO
NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITES, BY CENSUS DIVISION: UNITED STATES, 1800-1860

Census Division	1800	1810	1820	1830	1840	1850	1860
New England	322	307	288	271	257	228	228
Middle Atlantic	347	346	331	313	297	268	268
South Atlantic	351	344	339	325	329	301	292
East North Central	396	394	379	369	342	313	301
East South Central	404	391	377	372	361	324	310
West North Central			365	390	360	327	320
West South Central		386	319	331	329	309	315
Mountain						287	254
Pacific						75	217
United States	346	344	334	325	316	286	284

Sources: U. S. Censuses. Cf. Appendix III.

differentials in the birth ratio have tended to diminish.[4] The question may be asked whether they so tended before the Civil War. Because arbitrary reclassifications of population—the result of changes in state boundaries and of the addition of new states—make the conventional measures of dispersion unsatisfactory, we chose as our measure of dispersion a weighted (by population) mean deviation of the crude birth ratio of a state or territory from the United States ratio. Formally, it can be written as $\Sigma \frac{p}{\Sigma p} \left| \frac{c}{p} - \frac{\Sigma c}{\Sigma p} \right|$, where p is the population of a state or territory and c the number of its children aged 0-9.[5]

[4] Cf. Wilson H. Grabill, Clyde V. Kiser, and Pascal K. Whelpton, *The Fertility of American Women*, New York 1958, p. 54; Bernard Okun, *Trends in Birth Rates in the United States since 1870*, Baltimore 1958, p. 28.

[5] Actual computation was carried out with the following formula which was derived from the formula in the text. If i denotes those states whose birth ratios are higher than the national ratio and j the other states,

$$\Sigma \frac{p}{\Sigma p} \left| \frac{c}{p} - \frac{\Sigma c}{\Sigma p} \right| = \frac{\Sigma p_i \left(\frac{c_i}{p_i} - \frac{\Sigma c}{\Sigma p} \right) + \Sigma p_j \left(\frac{\Sigma c}{\Sigma p} - \frac{c_j}{p_j} \right)}{\Sigma p}$$

$$= \frac{\Sigma c_i - \Sigma c_j + \frac{\Sigma c}{\Sigma p} (\Sigma p_j - \Sigma p_i)}{\Sigma p} = \frac{2 \Sigma c_i - \Sigma c - \frac{\Sigma c}{\Sigma p} (2 \Sigma p_i - \Sigma p)}{\Sigma p} .$$

When the weighted mean deviation of the birth ratio is divided by the United

In order to interpret this measure of dispersion, we may imagine that population is broken up into units of arbitrary but equal size and that *within* a state or territory the birth ratio is the same for every imaginary unit. Alternatively, making our assumption less rigorous, we may assume that all units have different birth ratios but the unit birth ratios *within* a state or territory are either all higher, or all lower, than the United States birth ratio. In both cases, the mean deviation of the birth ratios of these imaginary units would yield the same value as our measure of dispersion.

An advantage of the weighted mean deviation over the unweighted mean deviation is the fact that the former tends to be less affected by mere redrawing of state boundaries. For reclassification of one state into two, or two states into one, does change the unweighted mean deviation but it does not affect the weighted mean deviation, unless the two states, after reclassification in the case of division or before reclassification in the case of merger, stand on different sides of the average when states are ranked in the order of their birth ratios.

The result of computations reveals an interesting trend. As is seen in Table II-4, the weighted mean deviation increased until 1840 and then started to fall off. When the mean deviation is expressed as a percentage of the United States birth ratio, the peak came a decade later. The geographical differentials in the crude birth ratio of the white population increased until 1840 or 1850, when the trend was reversed.

2. *Movement of the Crude Birth Ratios of the White Population of States and Territories over Time*

The rapid decline in the crude birth ratio, which was observed on the national level, also characterizes the movement of the crude

States birth ratio, it becomes the same thing as what is called the coefficient of localization.

$$\frac{\Sigma \frac{p}{\Sigma p}\left|\frac{c}{p}-\frac{\Sigma c}{\Sigma p}\right|}{\frac{\Sigma c}{\Sigma p}} = \Sigma \frac{p}{\Sigma c}\left|\frac{c}{p}-\frac{\Sigma c}{\Sigma p}\right| = \Sigma\left|\frac{c}{\Sigma c}-\frac{p}{\Sigma p}\right| .$$

Cf. United States National Resources Planning Board, *Industrial Location and National Resources*, Washington 1943, p. 107.

TABLE II-4

WEIGHTED[a] MEAN DEVIATION OF THE WHITE CRUDE BIRTH RATIO[b] OF A STATE OR TERRITORY FROM THE WHITE CRUDE BIRTH RATIO OF THE UNITED STATES, 1800-1860

	1800	1810	1820	1830	1840	1850	1860
Weighted mean deviation (per 1,000)	20.3	21.4	24.2	31.3	32.0	30.6	25.4
Mean deviation as percentage of the United States birth ratio	5.9	6.2	7.2	9.5	10.1	10.7	9.0

Note: *a.* Weight used is the white population of a state or territory. *b.* The crude birth ratio is the number of children under 10 years of age per 1,000 population.

Source: U. S. Censuses. Cf. Appendix III.

birth-ratio of almost every state and terirtory [6] (Table II-5). The decline was particularly general in older states and most of the few decennial increases took place in new and sparsely populated states or territories such as Georgia, Illinois, Alabama, Mississippi, and Louisiana, in 1820-1830, Florida in 1840-1850, and Wisconsin and California in 1850-1860.

TABLE II-5

DECENNIAL CHANGE IN THE WHITE CRUDE BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITES, BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800-10	1810-20	1820-30	1830-40	1840-50	1850-60
New England						
Maine	11	21	13	12	39	16
New Hampshire	19	24	19	11	36	5
Vermont	31	42	12	15	34	10
Massachusetts	7	20	22	13	19	+10
Rhode Island	7	8	18	25	14	3
Connecticut	12	19	21	12	22	+ 8

[6] Because of changes in political boundaries, sometimes the ratios for the same state or territory are not comparable through time. References are made in the text only when the state or territorial boundaries remained the same for the period under consideration or when the changes were minor as they were in Virginia between 1840 and 1850, in Ohio between 1830 and 1840 and in Indiana between 1810 and 1820.

State or territory	1800-10	1810-20	1820-30	1830-40	1840-50	1850-60
Middle Atlantic						
New York	+ 3	24	19	24	33	+ 3
New Jersey	16	8	16	8	24	3
Pennsylvania	2	8	16	7	25	2
South Atlantic						
Delaware	+18	16	17	5	15	7
Maryland	4	7	22	+ 4	18	1
Virginia	7	6	6	7	26[a]	2
North Carolina	7	6	9	5	35	8
South Carolina	7	12	6	8	35	14
Georgia		11	+10	3	38	21
Florida				43	+22	18
East North Central						
Ohio		19	19	20[a]	35	7
Indiana		4[a]	0	43	20	17
Illinois			+19	43	29	15
Michigan					25	23
Wisconsin						+13
East South Central						
Kentucky	14	18	12	11	28	9
Tennessee	11	14	6	14	42	17
Alabama			+ 6	16	49	12
Mississippi			+ 6	5	28	29
West North Central						
Iowa						10
Missouri					40	9
West South Central						
Arkansas				5	27	11
Louisiana			+ 5	10	32	+10
Texas						1
Pacific						
California						+157
U. S.	2	10	9	9	30	2

Note: *The sign is minus unless indicated otherwise. a.* These states underwent a slight territorial change in this decade.
Source: Table II-1.

General as it was, the decline of the crude birth ratio of a state over time was by no means smooth. Rather, it was characterized by ups and downs from one decade to another. There may seem to have been some tendency for the magnitudes of decennial decline to move concertedly in different states. For example, in 11 of the 16 states for which the crude birth ratios are comparable throughout the period 1800-1860, the largest absolute

decennial decline took place in 1840-1850, and in ten of the 16 states the smallest decennial decline (or largest increase) occurred in 1850-1860. However, this may have been largely the result of the unusually large underenumeration of children under 10 in 1850. So far as those 16 states were concerned, there was no

TABLE II-6

DECREASE IN THE WHITE CRUDE BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITES, IN THE SIXTEEN 'ORIGINAL' STATES[a]: UNITED STATES, 1800-1860

State	Absolute decrease	Relative decrease as the percentage of the 1800 figure
Maine	122	33.6%
New Hampshire	124	37.5
Vermont	144	38.5
Massachusetts	71	23.7
Rhode Island	75	25.2
Connecticut	78	25.9
New York	94	26.8
New Jersey	75	21.9
Pennsylvania	60	17.3
Delaware	42	13.2
Maryland	48	14.9
Virginia	53	15.2
North Carolina	70	19.3
South Carolina	82	22.3
Kentucky	92	22.8
Tennessee	104	25.3
Average of the 16 states	76	22.1
United States	62	17.9

Note: *a*. The states whose boundaries in 1860 were approximately the same as in 1800.
Source: Table II-1.

definite tendency for the fall in the crude birth ratio to be accelerated or retarded during the course of the 60 years. In the case of newer states and territories, however, there was usually a period of a stagnating or even a rising ratio which was followed by that of a rapid fall.

The magnitude of the decline in the crude birth ratio between 1800 and 1860 differs from state to state, ranging from the low of 42 per 1,000 for Delaware to the high of 144 per 1,000 for

Vermont (Table II-6). The crude birth ratio fell most rapidly, both absolutely and relatively, in the northern New England states and least rapidly in the states in the northern half of the South Atlantic Division. The states in southern New England, in the Middle Atlantic Division, and in the southern part of the South Atlantic Division occupied intermediate positions. The fall in the crude birth ratio in the new states of Kentucky and Tennessee was, in absolute terms, almost as large as that in northern New England states, but since the initial level of the birth ratio in the former states was extremely high, the relative decline was smaller and comparable with that of the southern New England states.

In most of the 16 'original' states the crude birth ratio decreased more rapidly than the United States birth ratio did. Only Pennsylvania, Delaware, Maryland, and Virginia showed smaller absolute and relative decline in the crude birth ratio than the United States as a whole. This is not so much because these four states were relatively populous but because (1) the birth ratios of the new areas to which population shifted were higher than those in the 16 'original' states and (2) the birth ratios of these newer states and territories decreased rather slowly or even increased for two or three decades at first. The weighted average of the crude birth ratios of the 16 'original' states decreased by 76 per 1,000 or 22.1% between 1800 and 1860 while the United States ratio fell by only 62 per 1,000 or 17.9%.

3. *Refined Birth Ratios of the White Population of States and Territories*

The refined birth ratios, or the number of children under 10 years of age per 1,000 women aged 16-44 (Table II-7), is obtained by dividing the crude birth ratio by the proportion of women of child-bearing age in the total population as is easily seen in the formula below.

$$\text{Refined birth ratio} = 1{,}000 \times \frac{\text{Number of Children Aged 0-9}}{\text{Population}} \div \frac{\text{Number of Women Aged 16-44}}{\text{Population}} .$$

The proportion of women of child-bearing age differed not only from state to state at a point of time but from year to year within a state. (Table II-8) As this proportion changed from

TABLE II-7

WHITE REFINED BIRTH RATIO

NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITE WOMEN AGED 16-44, BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	1974	1883	1621	1463	1416	1217	1108
New Hampshire	1704	1558	1385	1207	1112	915	900
Vermont	2068	1788	1468	1341	1286	1131	1079
Massachusetts	1477	1421	1269	1064	987	857	895
Rhode Island	1455	1405	1314	1139	989	910	887
Connecticut	1512	1438	1280	1114	1040	915	930
Middle Atlantic							
New York	1871	1895	1706	1466	1273	1070	1063
New Jersey	1822	1736	1629	1457	1360	1208	1150
Pennsylvania	1881	1841	1748	1536	1456	1322	1293
South Atlantic							
Delaware	1509	1687	1596	1393	1332	1314	1269
Maryland	1585	1598	1509	1302	1284	1237	1207
Virginia	1954[b]	1777[b]	1710[b]	1587[b]	1544[b]	1421	1408
North Carolina	1920	1857	1822	1645	1606	1389	1351
South Carolina	2030	1951	1851	1681	1635	1357	1324
Georgia	2116[a]	2103	2002	1962	1966	1672	1508
Florida				1899	1705	1726	1568
East North Central							
Ohio	2550[ae]	2303[b]	2131[b]	1871[b]	1696	1466	1360
Indiana	2014[a]	2307[b]	2235	2139	1835	1702	1531
Illinois		2201[a]	2235	2175	1869	1607	1471
Michigan		2121[a]	1826[a]	1834[a]	1602	1463	1301
Wisconsin					1569[a]	1493	1594
East South Central							
Kentucky	2371	2271	2070	1891	1890	1597	1517
Tennessee	2424	2302	2204	2033	1916	1594	1483
Alabama			2252	2198	2075	1637	1536
Mississippi	2509[a]	2089[a]	2222	2113	2053	1776	1582
West North Central							
Minnesota						1508[a]	1619
Iowa					1837[a]	1726	1636
Missouri		2375[ad]	2189[a]	2223[a]	1960	1581	1532
Dakota							1157
Nebraska							1460
Kansas							1496

State or territory	1800	1810	1820	1830	1840	1850	1860
West South Central							
Arkansas			2159[a]	2205	2160	1843	1727
Louisiana		1904[ac]	1845	1738	1597	1294	1320
Texas						1745	1761
Mountain							
Colorado							764
New Mexico						1265[a]	1406
Utah						1513[a]	2004
Nevada							1270
Pacific							
Washington							1847
Oregon						2005[a]	2104
California						1111	1287
United States	1844	1824	1735	1586	1514	1335	1308

Note: *a*. These figures are not comparable with later figures because of territorial changes. *b*. Strictly speaking, these figures are not comparable with later figures for the same reason. But the territorial changes involved are rather minor in these cases and are disregarded in the analysis in the text. *c*. Orleans Territory. *d*. Louisiana Territory. *e*. The Territory Northwest of the River Ohio.

Source: U. S. Censuses. Cf. Appendix III.

TABLE II-8

NUMBER OF WHITE WOMEN AGED 16-44 PER 1,000 WHITES, BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	184	188	199	211	210	212	218
New Hampshire	194	200	208	223	223	231	230
Vermont	181	192	206	216	214	213	214
Massachusetts	203	205	214	235	240	255	254
Rhode Island	204	207	215	232	243	248	251
Connecticut	199	201	211	224	228	235	240
Middle Atlantic							
New York	187	186	193	211	225	236	240
New Jersey	188	188	196	206	216	223	252
Pennsylvania	184	187	192	208	215	218	221

State or territory	1800	1810	1820	1830	1840	1850	1860
South Atlantic							
Delaware	211	200	201	218	224	225	205
Maryland	203	199	206	222	228	222	227
Virginia	179 [b]	192 [b]	196 [b]	209 [b]	210 [b]	209	210
North Carolina	188	191	192	206	208	216	216
South Carolina	180	185	188	203	222	220	216
Georgia	177 [a]	178	179	189	188	198	206
Florida				181	176	187	194
East North Central							
Ohio	160 [ae]	172 [b]	177 [b]	192 [b]	200	207	214
Indiana	179 [a]	172 [b]	176	183	190	193	204
Illinois		169 [a]	167	181	187	200	208
Michigan		147 [a]	150 [a]	177 [a]	204	206	214
Wisconsin					179 [a]	206	201
East South Central							
Kentucky	169	171	178	188	193	200	204
Tennessee	170	174	175	186	191	203	207
Alabama			171	178	180	199	205
Mississippi	150 [a]	171 [a]	164	175	178	189	195
West North Central							
Minnesota						180 [a]	206
Iowa					185 [a]	197	201
Missouri		163 [ad]	167 [a]	176 [a]	185	204	205
Dakota							198
Nebraska							196
Kansas							205
West South Central							
Arkansas			168 [a]	172	173	188	194
Louisiana		172 [ac]	169	182	192	213	216
Texas						187	185
Mountain							
Colorado							29
New Mexico						225 [a]	213
Utah						199 [a]	193
Nevada							55
Pacific							
Washington							113
Oregon						148 [a]	154
California						39	155
United States	187	189	193	206	209	215	217

Note: *a*. These figures are not comparable with later figures because of territorial changes. *b*. Strictly speaking, these figures are not comparable with later figures for the same reason. But the territorial changes involved are rather minor in these cases and are disregarded in the analysis in the text. *c*. Orleans Territory. *d*. Louisiana Territory. *e*. The Territory Northwest of the River Ohio.

Source: U. S. Censuses. Cf. Appendix III.

state to state, the state differential in the refined birth ratio shows a different pattern from that shown by the state differential in the crude birth ratio. And as this proportion changed from one census year to another, the refined birth ratio of a state changed over time in a different way than the crude birth ratio did.

The rankings of states or territories with respect to their refined birth ratios (Table II-9) were largely similar to the rankings

TABLE II-9

RANKS OF STATES AND TERRITORIES WITH RESPECT TO THE WHITE REFINED BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITE WOMEN AGED 16-44: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1960
New England							
Maine	9	13	19	19	20	27	34
New Hampshire	15	21	23	24	26	32.5	38
Vermont	6	16	22	22	23	29	35
Massachusetts	19	23	26	27	29	35	39
Rhode Island	20	24	24	25	28	34	40
Connecticut	17	22	25	26	27	32.5	37
Middle Atlantic							
New York	13	12	17	18	25	30	36
New Jersey	14	18	18	20	21	28	33
Pennsylvania	12	15	15	17	19	22	27
South Atlantic							
Delaware	18	19	20	21	22	23	30
Maryland	16	20	21	23	24	26	31
Virginia	10	17	16	16	18	19	20
North Carolina	11	14	14	15	14	20	23
South Carolina	7	10	11	14	13	21	24
Georgia	5	8	10	8	4	8	15
Florida				10	11	5.5	10
East North Central							
Ohio	2[ae]	3[b]	8[b]	11[b]	12	17	22
Indiana	8[a]	2[b]	2	5	10	7	13
Illinois		6[a]	3	4	8	10	18
Michigan		7[a]	13[a]	12[a]	15	18	26
Wisconsin					17[a]	16	8
East South Central							
Kentucky	4	5	9	9	7	11	14
Tennessee	3	4	5	7	6	12	17
Alabama			1	3	2	9	11
Mississippi	1[a]	9[a].	4	6	3	3	9

State or territory	1800	1810	1820	1830	1840	1850	1860
West North Central							
Minnesota						15	7
Iowa					9[a]	5.5	6
Missouri		1[a,d]	6[a]	1[a]	5	13	12
Dakota							32
Nebraska							19
Kansas							16
West South Central							
Arkansas			7[a]	2	1	2	5
Louisiana		11[a,c]	12	13	16	24	25
Texas						4	4
Mountain							
Colorado							41
New Mexico						25[a]	21
Utah						14	2
Nevada							29
Pacific							
Washington							3
Oregon						1[a]	1
California						31	28

Note: *A higher rank means a higher birth ratio. a.* The refined birth ratio of the state in this census year is not comparable with that in later years because of territorial changes. *b.* These states also underwent territorial changes but the changes were so minor as to be neglected in their effect on the refined birth ratio. *c.* Orleans Terirtory. *d.* Louisiana Territory. *e.* The Territory Northwest of the River Ohio.

Source: Table II-7.

of the same states or territories with respect to their crude birth ratios; the refined birth ratios tended to be higher in newer areas than in older and in the South than in the North. Most of the significant differences in the two rankings are found in new states and territories, such as Michigan and Orleans in 1810, Michigan, Mississippi, and Louisiana in 1820, Florida and Wisconsin in 1840, Minnesota, Oregon, and California in 1850 and Utah, Nevada, Washington, and California in 1860. In all of these cases, the disturbing factor was an unusually low proportion of women of child-bearing age in total population and, therefore, the refined birth ratios of these states were relatively higher than their crude birth ratios. Consequently, the ranks of these states which were rather out of line in the crude birth ratio were more conforming to the general pattern in the refined birth ratio.

Partly because the number of children under 10 years of age appears not only as the numerator but also in the denominator of the crude birth ratio, and partly because the proportions of women of child-bearing age in the population 10 years of age and older in newer states and territories, where fertility rates were higher, tended to be smaller,[7] part of the differentials in the refined birth ratios of states and territories were concealed in the differentials in the crude birth ratios.[8] The mean deviation of the refined birth ratio of a state or territory from the United States ratio

TABLE II-10

WEIGHTED[a] MEAN DEVIATION OF THE WHITE REFINED BIRTH RATIO[b] OF A STATE OR TERRITORY FROM THE WHITE REFINED BIRTH RATIO OF THE UNITED STATES, 1800-1860

	1800	1810	1820	1830	1840	1850	1860
Mean deviation of the refined birth ratio (per 1,000)	183	180	203	237	251	217	184
Mean deviation of the refined birth ratio as percentage of the United States refined birth ratio	9.9	9.8	11.7	14.9	16.6	16.3	14.1
Mean deviation of the crude birth ratio as percentage of the United States crude birth ratio	5.9	6.2	7.2	9.5	10.1	10.7	9.0

Note: *a*. Weight used is the number of white women aged 16-44. *b*. The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44.

Source: U. S. Censuses. Cf. Appendix III.

[7] Kendall's coefficients of rank correlation between the proportion of white women aged 16-44 in white population 10 years of age and older and the white refined birth ratio in successive censuses between 1800 and 1860 are, .453, .348, .477, .413, .429, .405, and .224. All the coefficients are significant at least at the 5% level.

[8] If the variation in the proportion of women of child-bearing age in the population 10 years of age and older was large, it is possible that the differentials in the refined birth ratios were overcompensated in the crude birth ratios with the result that there was an inverse association between the crude and refined birth ratios. Howver, except in a few sparsely populated states and terirtories, the proportions of women of child-bearing age were within a small range, and the ranks of states and territories were little affected by this factor.

weighted by the number of women of child-bearing age and expressed as a percentage of the United States refined birth ratio, was much larger than the comparable measure of dispersion of the crude birth ratio of a state or territory (Table II-10).

Over time, the proportion of women of child-bearing age in the total population increased quite systematically, partly because the fertility of women fell and partly because the proportion of women of child-bearing age in the population 10 years of age and older increased.[9] Newer states and territories particularly showed tendencies of rapid increase; most of the decennial decrease took place in the Atlantic seaboard states.

The increase of the proportion of women of child-bearing age means that the downward trend of the crude birth ratio understates the fall of the fertility of white women. Some idea of the extent of this understatement may be gained by a comparison of the relative decline of the crude and refined birth ratios of the 'sixteen original states' (Table II-11). Whereas the crude birth ratio of the 16 states combined declined only 22.1% between 1800 and 1860 the refined birth ratio fell 34.8% in this period. For the United States the rate of decline of the refined birth ratio was 29.0%, while the rate of decline of the crude birth ratio was only 17.9%.

The geographic pattern of declines in the refined birth ratios was similar to that of declines in the crude birth ratios from 1800 to 1860. The refined birth ratio fell most rapidly in those states that were new in 1800 such as Vermont, Maine, and New Hampshire in northern New England and such as Kentucky and Tennessee in the inland. States in the northern part of the South Atlantic Division such as Delaware, Maryland, and Virginia showed the smallest declines.

Again like the crude birth ratio, the refined birth ratio in most older states fell more rapidly than the United States refined birth ratio did. Of the 16 'original' states for which the refined birth ratio is comparable from 1800 to 1860, only Delaware and Maryland showed smaller absolute declines, and only Delaware, Maryland, and Virginia showed smaller relative declines, than the United States as a whole. In newer areas, the refined birth ratio remained relatively stagnant for a decade or two and then started to fall very rapidly (Table II-12).

[9] The proportion of white women aged 16-44 in the white population 10 years of age and older increased from 28.7 in 1800 to 30.3 in 1860.

TABLE II-11

DECREASE IN THE CRUDE AND REFINED BIRTH RATIOS[a] OF THE WHITE POPULATION IN THE SIXTEEN 'ORIGINAL' STATES[b]: 1800-1860

State	Crude Birth Ratio: Absolute decrease (per 1,000)	Crude Birth Ratio: Relative decrease as the percentage of the 1800 ratio	Refined Birth Ratio: Absolute decrease (per 1,000)	Refined Birth Ratio: Relative decrease as the percentage of the 1800 ratio
Maine	122	33.6%	866	43.8%
New Hampshire	124	37.5	804	47.2
Vermont	144	38.5	989	47.8
Massachusetts	71	23.7	582	39.4
Rhode Island	75	25.2	568	39.0
Connecticut	78	25.9	582	38.5
New York	94	26.8	808	43.2
New Jersey	75	21.9	672	36.8
Pennsylvania	60	17.3	588	31.2
Delaware	42	13.2	240	15.9
Maryland	48	14.9	378	23.8
Virginia	53	15.2	546	27.9
North Carolina	70	19.3	569	29.6
South Carolina	82	22.3	706	34.8
Kentucky	92	22.8	851	35.9
Tennessee	104	25.3	941	38.8
Average of the 16 states	76	22.1	629	34.8
U. S.	62	17.9	536	29.0

Note: *a*. The crude birth ratio is the number of children under 10 years of age per 1,000 population and the refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44. *b*. The states whose boundaries in 1860 were approximately the same as in 1800.

Source: Tables II-6 and II-7.

TABLE II-12

DECENNIAL CHANGE IN THE WHITE REFINED BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITE WOMEN AGED 16-44, BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800-10	1810-20	1820-30	1830-40	1840-50	1850-60
New England						
Maine	41	262	158	47	199	109
New Hampshire	146	173	178	95	197	15
Vermont	280	320	127	55	155	52
Massachusetts	56	152	205	77	130	+38
Rhode Island	50	91	175	150	79	23
Connecticut	74	158	166	74	125	+15

State or territory	1800-10	1810-20	1820-30	1830-40	1840-50	1850-60
Middle Atlantic						
New York	+25	189	240	193	203	7
New Jersey	86	107	172	97	152	58
Pennsylvania	40	93	212	80	134	29
South Atlantic						
Delaware	+178	91	203	61	18	45
Maryland	+13	89	207	18	47	30
Virginia	177	67	123	43	223[a]	13
North Carolina	63	35	177	39	217	38
South Carolina	79	100	179	46	278	33
Georgia		101	40	+4	294	164
Florida				194	+21	158
East North Central						
Ohio		172	260	175[a]	230	106
Indiana		72[a]	96	304	133	171
Illinois			60	306	262	136
Michigan					139	162
Wisconsin						101
East South Central						
Kentucky	100	201	179	1	293	80
Tennessee	122	98	171	117	322	111
Alabama			54	123	438	101
Mississippi			109	60	277	194
West North Central						
Iowa						90
Missouri					379	49
West South Central						
Arkansas				35	317	116
Louisiana			107	141	303	+26
Texas						16
Pacific						
California						176
U.S.	20	89	149	77	179	27

Note: *The sign is minus unless indicated otherwise.* *a.* These states underwent a slight territorial change in this decade.

Source: Table II-7.

4. *Summary and Further Remarks*

There were wide differentials in the birth ratios of different states and territories throughout the period 1800-1860. Roughly speaking, the crude and refined birth ratios at a point of time were higher in newer states and territories than in older states and higher in the South than in the North. Older states in New England had the lowest birth ratios in 1800 and continued to do so for the rest of the period. The highest birth ratios were found in territories and newest states in each census year, although some of the new and sparsely populated territories showed relatively low refined birth ratios and still lower crude birth ratios.

The geographical differentials in the birth ratios increased until around 1840, when the trend was reversed. The differentials in the refined birth ratios were relatively greater than the differentials in the crude birth ratios.

The relative levels of the refined birth ratios do not necessarily represent the relative levels of fertility. The refined birth ratios are affected by a number of factors which cause them to diverge from fertility: such as the relative degree of underenumeration of children in relation to the underenumeration of women of child-bearing age, the mortailty of children, the age-distribution of women of child-bearing age, and the rate of increase of yearly births attributable to the population which resided, or would have resided if alive, in the United States at a census date. Most of these miscellaneous factors will be discussed in later chapters. Here only this much can be said, that it is the concensus of opinion of demographers that the relative degree of underenumeration of children in relation to the underenumeration of women in a census probably did not differ much—certainly not so much as the degree of underreporting of births—from one state to another.[10] If there was a systematic variation in the relative degree of underenumeration of children, the underenumeration was probably greater in newer states and terirtories with higher refined birth ratios and, hence, the differentials in fertility may have been larger than the differentials in the refined birth ratios.

The existence of wide differentials as early as 1800 coupled with

[10] P. K. Whelpton, "The Completeness of Birth Registration in the United States," *Journal of the American Statistical Association*, June 1934, 29, p. 126; Walter F. Willcox, *Introduction to the Vital Statistics of the United States, 1900 to 1930*, Washington 1933, p. 79.

the widening of differentials before 1840 leads one to suspect that the birth ratios in older states may have started to fall well back in the eighteenth century. A look at colonial and continental census records (Table II-13) reveals that this was probably the

TABLE II-13

RATIO OF WHITE CHILDREN TO WHITE WOMEN FOR SEVERAL COLONIES AND STATES: BRITISH AMERICA AND UNITED STATES, 1726-1800

Colony or state	Year	Ratio (per 1,000)
A. Number of White Children under 16 Years of Age per 1,000 White Women 16 Years of Age and Older		
Massachusetts	1764	1,734
	1800	1,569
Rhode Island	1774	1,634
	1850	1,568
New York[c]	1746[a]	2,009
	1749	1,904
	1756	1,889
	1771[b]	1,777
	1786	1,911
	1800	1,722
New Jersey	1726	2,021
	1737-8	1,896
	1800	2,019
Maryland	1755	2,072
	1800	1,865
B. Number of White Children under 10 Years of Age per 1,000 White Women 10 Years of Age and Older		
Connecticut	1774	952
	1800	839
New York	1737	947
	1800	1,133

Note: *a*. Albany County was not included " on account of the enemy." *b*. Cumberland and Gloucester, Vermont, which were included in the original table were excluded. *c*. A few other New York censuses were neglected either because of ambiguity in the method of classification or because of obvious mistakes in the table.

Source: U. S. Bureau of the Census, *A Century of Population Growth in the United States, 1790-1900*, Washington 1909, pp. 158-185.

case. Although the New York ratios for 1737 and 1786 and the New Jersey ratio for 1800 were not in line with other ratios, general downward trends in the ratios of children to women are unmistakable.

After 1800, the crude and refined birth ratios of states and territories fell in almost every decade. On the one hand, the fall in the birth ratios of older states, though it was full of fluctuations, did not reveal any definite sign of acceleration or of retardation. On the other hand, the birth ratios of new areas tended to be stagnant for a decade or two before a rapid decline set in. Mainly because of the shift of population from old areas with low birth ratios to new areas with high birth ratios and partly due to the stagnation of the birth ratio in new areas at the beginning, the birth ratios of older states tended to decrease more rapidly than the United States ratio. Among the 16 'original' states, for which the birth ratios are comparable from 1800 to 1860, the northern New England states of Vermont, New Hampshire, and Maine and the inland states of Kentucky and Tennessee witnessed the most rapid declines. The states in the northern part of the South Atlantic Division were marked with the slowest falls.

Chapter III

MORTALITY

In Chapter II we noted (1) wide differentials among different states and territories in the white refined birth ratios, or the numbers of white children under 10 years of age per 1,000 white women of child-bearing age, and (2) downward trends in the ratios within states and territories over time. However, we cannot be sure as yet that these differentials and trends relate chiefly to fertility; they may be accounted for mostly by differentials and trends in the mortality of children. To shed some light on this question, data on mortality are examined in this chapter.

Few data are available on levels and trends of mortality in the United States before the Civil War. The registration records of a few states for the last decade of the period, mortality statistics in the United States Censuses of 1850 and 1860, records of deaths kept by a handful of cities and towns, and some genealogical rceords are all that we have.

1. *Relative Levels of Mortality in Different States and Territories*

Some contemporary social scientists, relying upon the fragmentary data on the mortality experiences of several cities, tried to infer the relative healthfulness of different regions. For example, Samuel Blodget held that mortality was higher in the South than in the North.[1] Ezra Seaman was also of the opinion that the general mortality was higher in the South than in the North, although he thought that the mortality of infants was probably higher in the North.[2]

These observations are in accord with what might be expected

[1] Samuel Blodget, *Economica: A Statistical Manual for the United States of America*, Washington 1806, p. 77.

[2] Ezra C. Seaman, *Essays on the Progress of Nations*, New York 1846, pp. 320, 379-381.

for regions of different climatic conditions and of similar social setting. Supporting evidence can be found in the higher mortality in summer months than in winter;[3] high temperature was supposed to be conducive to the spread of numerous infectious diseases.

However, social conditions were by no means similar in different parts of the country in the middle of the nineteenth century. Industrialization and urbanization had already progressed to a considerable extent in the North while the South remained largely agricultural. If the degree of urbanization affected mortality, what might be said about the relative levels of mortality in the cities of different regions does not necessarily apply to whole regions.

This seems to have been the case for this period. While the United States in general was considered to be healthier than Europe, sanitary conditions in cities in this country in the middle of the nineteenth century were bad. Numerous remarks by city officials and medical authorities on filthiness and overcrowding, deficient ventilation, improper drainage, scanty water supply and the resultant rage of infectious diseases and high mortality bear testimony to this.[4]

The life table constructed by Jaffe and Lourie from the records of New England towns, New York City, and Philadelphia clearly shows an urban-rural mortality differential large enough to have important effects in the determination of the relative levels of mortality in regions with different degrees of urbanization (Table III-1). The urban-rural differential seems to be particularly large in the very young and very old age-classes. No mortality rate was computed for the age-class 0-4 but the extrapolation of the trend points to a still larger differential for it than for the age-class 5-9.

The enumerations of deaths during one year preceding the census dates of 1850 and 1860 are the only available records of mortality covering all the states and territories. These records, however, suffer from two major defects. First, mortality experiences during only one year out of a decade were recorded. In the

[3] U. S. Census Office, *Report on the Mortality and Vital Statistics of the United States as Returned at the Tenth Census, 1880*, Part I, Washington 1885, p. xlvi.

[4] New York City, Board of Health, *Annual Report of the Resident Physicians of the City of New York for 1865*, New York 1866, p. 7; National Institute, Medical Department, "Communication on Hygiene," *The Transactions of the American Medical Association*, 1848, 1, p. 307; George Chandler Whipple, *State Sanitation: A Review of the Work of the Massachusetts State Board of Health*, Vol. I, Cambridge 1917, p. 287; Lemuel Shattuck, "On the Vital Statistics of Boston," *The American Journal of the Medical Sciences*, April 1841, 1, p. 383.

days when infectious diseases were the most important cause of death, death rates in different parts of the country fluctuated widely and differently from year to year. Under such circumstances it is dangerous to draw a conclusion concerning the relative levels of mortality in different states and territories from the experience of one or two census years.

TABLE III-1

AGE-SPECIFIC DEATH RATE FOR THE WHITE POPULATION, BY URBAN-RURAL RESIDENCE: UNITED STATES, 1830

Age	U. S. (per 1,000)	Rural areas[a] (per 1,000)	Salem and New Haven (per 1,000)	Boston New York and Philadelphia (per 1,000)
5–9	5.5	5.1	7.1	12.5
10–14	3.0	2.9	3.3	5.8
15–19	5.4	5.3	5.4	7.4
20–29	8.9	8.4	10.7	17.3
30–39	11.5	10.5	14.0	29.2
40–49	12.6	11.2	17.9	39.3
50–59	17.2	15.5	25.0	47.2
60–69	29.0	26.5	41.2	70.0
70–79	63.3	59.1	88.8	125.9

Note: *a*. 44 towns in New England.

Source: A. J. Jaffe and W. I. Lourie, Jr., "An Abridged Life Table for the White Population of the United States in 1830," *Human Biology*, September 1942, 14, p. 357.

Second, it is known that only a part, although probably the greater part, of the deaths which actually occurred during the course of a year were recorded. It is also clear that the extent of underenumeration was not the same in different censuses. However, as to the relative extent of underenumeration in different states and territories in one census, opinions seem to have been divided even within the Census Office.

Joseph C. G. Kennedy, superintendent of the Census of 1850, was of the opinion that though the returns of the number of deaths might turn out to be too small, this would "not affect their value, for the purposes of comparison of one portion of the country with another, or cause with effect."[5] The report on

[5] U. S. Census Office, *The Seventh Census: Report of the Superintendent of the Census for December 1, 1852, to Which Is Appended the Report for December 1, 1851*, Washington 1853, p. 137.

mortality which was prepared by James D. B. De Bow, successor of Kennedy, and published two years later took a different and rather extreme position and stated:

> The varying ratios between the States, as drawn from the returns, show not so much in favor of or against the health of either, as they do, in all probability, a more or less perfect report of the marshals. Thus it is impossible to believe Mississippi a healthier State than Rhode Island, etc.[6]

Kennedy, who was reappointed superintendent of the Census of 1860, clung to his previous position in his preliminary report on the Eighth Census and argued that "being taken in the same manner over extensive sections of country, the returns stand on the same footing, and though not the whole, will be regarded as very large examples of repersentative numbers of the whole. . . ."[7] The position was again reversed in the report on mortality published after Kennedy left the office.[8]

Census reports of later years took the same position as the mortality reports for 1850 and 1860 and held that the different levels of mortality in different states shown by the census returns indicate not so much the relative healthfulness of the states but the degree of completeness of the enumeration.[9]

Underenumeration came from two sources; families and enumerators. Every census report noted that it was impossible for each family to remember all the deaths which had taken place in the family during the past year. If this was the major cause of the underenumeration, there seems to be relatively little basis for a systematic difference in the degrees of underenumeration—although differences in educational levels and associated factors may have caused some systematic difference. Of course, simple

[6] U. S. House of Representatives, *Mortality Statistics of the Seventh Census of the United States, House Executive Documents No. 98, 33rd Congress, 2nd Session,* Washington 1855, p. 8.

[7] U. S. Census Office, *Preliminary Report on the Eighth Census, 1860,* by Joseph C. G. Kennedy, Washington 1862, p. 24.

[8] U. S. Census Office, *Statistics of the United States (Including Mortality, Property, &c.) in 1860,* Washington 1866, p. xxiv. For an account of the appointments and dismissals of superintendents, and the organization and disbanding of the Census Office, see Carroll D. Wright and William C. Hunt, *The History and Growth of the United States Census,* Washington 1900, pp. 49-51.

[9] U. S. Census Office, *Report on the Mortality and Vital Statistics of the United States as Returned at the Tenth Census, 1880,* Washington 1885, p. xviii; U. S. Census Office, *Twelfth Census of the United States: 1900, Vol. III, Vital Statistics, Part 1, Analysis and Ratio Tables,* Washington 1902, p. xi.

infallibility of human memory was not the only source of error from the side of those who were enumerated. Some families must have died out leaving nobody to report the deaths. Others might have been broken up and the deaths which occurred within the old household might have been left unreported. In these cases, there is some reason to suspect systematic difference in the degrees of reporting as the birth rate, the mobility of people and the organization of the family differed from a region to another. However, underenumeration due to these circumstances does not seem to be numerically very important for a period as short as one year.

Another source of error was the negligence and ignorance of the enumerators. It was quite possible that some enumerators were not inquisitive enough to record all the deaths which a family could remember. Others apparently made no inquiry about deaths.[10] But if there were many enumerators in one state, differences in enumerators' diligence may be expected to have cancelled out each other. In small states and territories, the effect of this factor may have been felt more strongly than in larger states and territories. In case different degrees of diligence stemmed from marshals rather than from enumerators, noticeable differentials on a state level might not be unexpected.

Do we know anything about the relative importance of these causes of underenumeration? Comparisons of census enumerators' returns with the registration returns in 1880 for Massachusetts and New Jersey may shed some light on the question (Table III-2). The enumeration in each state was more than 90% complete for May which was the nearest month to the census date. As we move further from the census date underenumeration increases gradually and systematically except that in June 1879, the farthest month from the census date, there is a sudden increase which was presumably due to the inclusion by some families of deaths which took place actually in May and April of 1879. The ratio of enumerated returns to registration returns for the month of July was only 64.7% in Massachusetts and 58.3% in New Jersey.[11] This seems to suggest that a considerable part of the deficiencies in the census enumeration was due either to the failure of human memory or to the disorganization of families, for deficiencies due

[10] *Ibid.*, p. xi.

[11] U. S. Census Office, *Report on the Mortality and Vital Statistics of the United States, 1880*, p. xlii.

to the negligence of census-takers would not result in an increasing completeness in enumeration in months closer to the census date.

In May, as the table shows, there was an underenumeration of deaths in the amount of 5.5% in Massachusetts and 7.8% in New Jersey. If we assume that these ratios constitute the maximum amount of underenumeration due to the negligence of enumerators for each month, the rest of the total deficiencies of 21.0% for Massachusetts and 26.7% for New Jersey would be, roughly

TABLE III-2

RATIO OF DEATHS ENUMERATED BY CENSUS TAKERS TO REGISTERED DEATHS: MASSACHUSETTS AND NEW JERSEY, JUNE 1879–MAY 1880

	Massachusetts	New Jersey
June 1879	72.8%	70.1%
July "	64.7	58.3
Aug. "	75.9	63.9
Sept. "	73.7	65.8
Oct. "	74.9	67.0
Nov. "	77.8	68.0
Dec. "	77.8	70.3
Jan. 1880	80.6	75.5
Feb. "	82.5	74.6
March "	83.2	81.8
April "	84.8	84.1
May "	94.5	92.2
Total	79.0	73.3

Source: U. S. Census Office, *Report on the Mortality and Vital Statistics of the United States, 1880*, pp. xlii, xliv.

speaking, the minimum amounts of underenumeration attributable to causes related to families. Thus, in Massachusetts at least 74%, and in New Jersey 71%, of the total deficiencies resulted from causes related to families.

From this it does not necessarily follow that the negligence of enumerators was a less important cause of underenumeration in every state and in every census. Perhaps Massachusetts and New Jersey happened to be two of the states in which enumerators were most diligent. Or, more likely, enumerators in the census of 1880 were better instructed than in previous censuses. All we can say is that a considerable part of the deficiencies resulted from the failure of memory or the breaking up of families. We would

expect that there would not be considerable differences in the degree of underenumeration from these causes in different states.

Thus we have some reason to suspect that the apparent differences in the death rates in different states and territories shown by the census returns may mean more than differences in the diligence of enumerators in different states. There is no way of knowing directly the extent of underenumeration in different states. All we can do is to examine the plausibility of the relative levels of mortality shown by the returns. Unfortunately, the number of deaths and death rates were given by race in 1850 only and, therefore our analysis has to be largely limited to 1850.

The crude death rate of the white population for different states in 1850 as shown in the census report are reproduced in the second column of Table III-3. A rather systematic regional pattern can be seen from the table. On the eastern seaboard death rates in the older New England and Middle Atlantic states were among the highest in the country. States in the lower Mississippi Valley were also among the high-death-rate states. The low-death-rate states can be classified into two kinds. Southern states, except those in the Mississippi Valley, and newer states in the North both in northern New England and in the Middle West.

It may be suspected that a difference in age-distribtuion may have caused some apparent differentials in the death rates. Therefore, death rates for children under 10 years of age, which are supposed to have been most sensitive to the healthfulness of environment, were computed for each state. As is seen in the third column of Table III-3, a similar geographic pattern still remains.

To see whether these rates are plausible, we examined the relationship between the death rate and several other variables.

Other things being equal, we would expect that, the higher the infant mortality, the higher the ratio of children under one to children under five. Kendall's coefficient of rank correlation between these two variables, between white infant mortality [12] and the ratio of white children under one to white children under five in a state, turned out to be .469 and significant at the 1% level of probability.[13] Since other things, (for example, the rate of

[12] For infant mortality the number of deaths under one during the previous year per number of the living under one was used.

[13] Data were taken from U. S. House of Rerpresentatives, *op. cit.*, p. 44. Here as in other correlation analyses in this Section three states (California, Delaware, and Florida) with small populations and all the territories were excluded from the sample.

TABLE III-3

DEATH RATE OF THE WHITE POPULATION BASED ON THE CENSUS RETURNS IN 1850, BY STATE: UNITED STATES

State	Crude death rate for whites (per 1,000)	Death rate for white children under 10 years of age (per 1,000)
New England		
Maine	13.0	20.1
New Hampshire	12.3	21.6
Vermont	10.0	12.5
Massachusetts	19.5	38.5
Rhode Island	15.1	27.1
Connecticut	15.6	24.0
Middle Atlantic		
New York	14.7	25.0
New Jersey	13.3	21.2
Pennsylvania	12.3	20.8
South Atlantic		
Delaware	13.3	21.3
Maryland	16.3	30.8
Virginia	11.0	14.2
North Carolina	10.2	11.8
South Carolina	10.2	12.2
Georgia	8.8	11.3
Florida	10.2	14.6
East North Central		
Ohio	14.6	22.2
Indiana	12.9	18.5
Illinois	13.8	20.4
Michigan	11.3	18.0
Wisconsin	9.5	17.1
East South Central		
Kentucky	14.0	18.4
Tennessee	10.8	13.6
Alabama	10.2	14.7
Mississippi	11.3	16.1
West North Central		
Iowa	10.6	17.3
Missouri	18.4	23.9
West South Central		
Arkansas	13.3	18.8
Louisiana	23.1	23.3
Texas	14.1	19.3
Pacific		
California	9.7	20.8
U. S.	13.5	20.5

Source: U. S. House of Representatives, *op. cit.*, p. 44.

growth of annual births, the number and the age-distribution of migrants, the extent of underenumeration of children under one year of age) were not equal, too much confidence should not be placed on the value of the coefficient. Nevertheless, the high positive value of the coefficient may be considered as evidence of the plausibility of the relative levels of mortality shown by the census report.

Another test is based on the fact that child or infant mortality of a high-mortality area tended to be much more than proportionately higher than that of a low-mortality area.[14] If the relative levels of death rates reported by the census ever resembled the real levels of mortality, we might expect that there were relatively more child deaths in high-death-rate states. To adjust for the difference in age-distribution, the ratio of the death rate for children under 10 to the unweighted average of the death rates for the age-classes 50-59, 60-69, and 70-79 was computed for each state. Kendall's coefficient of rank correlation between this ratio and the crude death rate is .577 and significant at the 1% level.

Turning to more indirect ways of evaluating the plausibility of the apparent mortality levels in different states, we examined the relationship between child mortality and several measures of industrialization and urbanization. Kendall's coefficient of rank correlation between white mortality under age ten and several socio-economic variables in a state turned out to be as follows:

Kendall's coefficient of rank correlation between the death rate for white children under 10 years of age and;[15]

Number of persons, white and colored, per square mile......	.323*
Proportion of whites employed in non-agricultural activities among total whites aged 15 and upward................	.548*
Proportion of urban population in the total population, white and colored......................................	.617**

[14] For example, around 1920, the infant mortality rate in Bulgaria was 1.7 times as high as that in Italy, while the crude death rate in the former was only 1.1 times as high as that in the latter. Likewise, the infant mortality rate in Italy was 2.3 times as large as that in New Zealand, while the crude death rate in the former was only 1.7 times as large as that in the latter. This is not due to the different age-distributions in these countries, for the general relationship does not change materially when rates are standardized for age-distribution. The unweighted average of death rates for ages 50, 60, and 70 in Bulgaria was 1.3 times as large as that in Italy, and the average rate in Italy was 1.1 times as large as that in New Zealand. Data were taken from Warren S. Thompson, *Population Problems*, New York 1930, pp. 134-135, 147. The average death rates for older ages in Bulgaria is an average of rates for ages 50, 60-64, and 70-74.

[15] * means " significant at the 5% level " and ** " significant at the 1% level."

These results show that the more urbanized and industrialized a state was, the higher its death rate tended to be. Again, this is what we would expect and, therefore, the relative levels of mortality shown by the enumerators' returns seem to be reasonable.

The evidence examined so far seems to lead us to the inference that the relative levels of mortality shown by the 1850 Census represented roughly the relative levels of actual mortality for the year ending June 1850. White mortality, more specifically mortality for white children under 10 years of age, was higher in the urban states in the New England and Middle Atlantic regions, as well as in the states in the lower Mississippi Valley. It was lower in the South outside the Mississippi Valley and in less urbanized states in the West.

Nevertheless, it would be hazardous to place too much confidence in the numerical values of the death rates. For one thing, there is no assurance that a single year is typical of years before and after it. For another, the number of deaths left unrecorded was believed to be at least 25%, possibly as much as 50%, of the total. Under such circumstances, differences in the degree of underenumeration due to purely random factors may disturb considerably the geographical pattern of relative mortality. Finally, we do not know whether there was any relationship between the degree of underenumeration and some other variables, such as the extent of urbanization, whose relationship with mortality we have examined. Thus, a part of what appeared to be the association between urbanization and mortality may have been the association between urbanization and the completeness of enumeration.

This may be the explanation, at least in part, for our inability to remove the differential in mortality by standardizing it for urban-rural residence. We computed the urban death rate for children aged 0-9 in a state assuming at first that the urban death rate in a state was 1.5 times as large as its rural death rate and then that the former was twice as large as the latter. If urban-rural residence was the only factor affecting mortality, the death rates of different states, when standardized for urban-rural residence, should become approximately the same. Actually wide differentials in the death rates still remain (See Table III-4) and so does the correlation between the degrees of urabnization and mortality. Kendall's coefficient of rank correlation between the proportion of urban population and the *estimated* death rate for urban white population under 10 years of age in a state is .566,

when urban mortality is assumed to have been 1.5 times as high as rural mortality, and .396, when the former is assumed to have been twice as high as the latter. Both coefficients are significant at the 1% level.

TABLE III-4

ESTIMATED DEATH RATE FOR WHITE CHILDREN UNDER 10 YEARS OF AGE LIVING IN CITIES, BY STATE: UNITED STATES, 1850

State	*A* (per 1,000)	*B* (per 1,000)
New England		
Maine	28.2	35.4
New Hampshire	29.8	36.9
Vermont	18.6	24.5
Massachusetts	46.1	51.1
Rhode Island	31.8	34.8
Connecticut	33.3	41.4
Middle Atlantic		
New York	32.9	39.0
New Jersey	29.2	36.1
Pennsylvania	27.9	33.7
South Atlantic		
Delaware	29.7	36.9
Maryland	39.8	46.6
Virginia	20.6	26.5
North Carolina	17.5	23.0
South Carolina	17.7	22.7
Georgia	16.6	21.7
Florida	21.9	29.2
East North Central		
Ohio	31.4	39.6
Indiana	27.1	35.4
Illinois	29.5	37.9
Michigan	26.0	33.6
Wisconsin	24.5	31.3
East South Central		
Kentucky	26.6	34.2
Tennessee	20.2	26.6
Alabama	21.6	28.1
Mississippi	23.9	31.6
West North Central		
Iowa	25.3	32.9
Missouri	31.4	39.6

State	A (per 1,000)	B (per 1,000)
West South Central		
Arkansas	28.2	37.6
Louisiana	30.9	37.0
Texas	28.4	47.3
Pacific		
California	30.1	38.7

Note: *A*. Urban mortality rate (d) is assumed to have been 1.5 times as high as rural mortality rate. d was computed by the following formula: $d = \frac{3\bar{d}}{u + 2}$, where $\bar{d}$ is the average mortality rate and u the proportion of urban population. Since the proportion of urban population is not given by age nor by race, the proportion of urban population, white and colored, of all ages was used. *B*. Urban mortality rate is assumed to have been twice as high as rural mortality rate. The formula used is $d = \frac{2\bar{d}}{u + 1}$.

Source: Table III-3 and Table V-3.

If it is unlikely that the urban mortality for this age-class was more than twice as high as the rural mortality, the explanation has to be sought either in the correlation between the degree of urbanization and mortality within urban and rural areas or in the correlation between the degree of urbanization and the completeness in reporting deaths, or in both. In view of the difference in mortality between large and small cities,[16] it is likely that the urban mortality of a state with a larger proportion of urban population was higher than the urban mortality of a state with a smaller proportion of urban population. Likewise, it is probable that mortality from infectious diseases of rural areas adjacent to urban areas was higher than mortality of rural areas without any city nearby. But it is also possible that the level of education and average intelligence were higher in more urbanized states than in rural states, and, as a result, families in the former tended to remember deaths in the families better than families in the latter and enumerators in the former tended to execute their jobs better than enumerators in the latter.

Despite these uncertainties about the numerical values of mortality it may be interesting to see how the introduction of differential mortality changes the picture of relative fertility as shown by the refined birth ratio, or the ratio of children under

[16] Cf. Table III-1.

10 years of age to women of child-bearing age. A survival factor[17] was estimated for each state from the death rate for white children under 10 in 1850, and the number of white children under 10 per 1,000 white women of child-bearing age in a state for 1850 was divided by the former to arrive at a rough estimate of the number of children born between 1840 and 1850 per 1,000 women of child-bearing age in 1850. At first 30%, then 50%, of the total deaths under 10 years of age were assumed to be left out by enumerators. The result is shown in Table III-5. An important conclusion is that the rank of a state with respect to

TABLE III-5

NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITE WOMEN AGED 16-44 IN 1850 AND ESTIMATED NUMBER OF WHITE BIRTHS DURING TEN YEARS PRECEDING THE CENSUS DATE IN 1850 PER 1,000 WHITE WOMEN AGED 16-44 IN 1850, BY STATE: UNITED STATES

	Ratio of children to women	Ratio of births to women	
		A	*B*
New England			
Maine	1,217	1,512	1,638
New Hampshire	915	1,154	1,253
Vermont	1,131	1,304	1,371
Massachusetts	857	1,235	1,453
Rhode Island	910	1,213	1,336
Connecticut	915	1,188	1,291
Middle Atlantic			
New York	1,070	1,533	1,529
New Jersey	1,208	1,518	1,648
Pennsylvania	1,322	1,653	1,796

[17] A survival factor, or the number of children under 10 years of age alive at a census date per birth during the preceding ten years, was estimated on an assumption that the function of age-specific death rate was geometrically similar to that for Massachusetts in 1855 within ages 0-9. First, from Elliott's life table for Massachusetts in 1855 (E. B. Elliott, "On the Law of Human Mortality that Appears to Obtain in Massachusetts with Tables of Practical Value Deduced Therefrom," *Proceedings of the American Association for the Advancement of Science*, 11th Meeting, 1857, p. 61) three life tables with age-specific mortality rates, twice, $\frac{2}{3}$, and $\frac{1}{2}$ of those in the Elliott table were constructed. Then, the general death rate for the life-table population were computed for all of the four life tables and plotted on a graph. The survival factor for each state, $\sum_{x=0}^{9} \frac{Lx}{10l_0}$, where Lx is the population aged x and l_0 the number of births in a life-table population, was estimated from the graph.

	Ratio of children to women	Ratio of births to women A	Ratio of births to women B
South Atlantic			
Delaware	1,314	1,653	1,795
Maryland	1,237	1,645	1,795
Virginia	1,421	1,668	1,763
North Carolina	1,389	1,591	1,667
South Carolina	1,357	1,558	1,635
Georgia	1,672	1,898	1,990
Florida	1,726	2,035	2,152
East North Central			
Ohio	1,466	1,860	2,022
Indiana	1,702	2,083	2,239
Illinois	1,607	2,001	2,172
Michigan	1,463	1,782	1,912
Wisconsin	1,493	1,803	1,931
East South Central			
Kentucky	1,597	1,955	2,102
Tennessee	1,594	1,858	1,961
Alabama	1,637	1,930	2,044
Mississippi	1,776	2,124	2,262
West North Central			
Iowa	1,726	2,087	2,236
Missouri	1,581	2,045	2,227
West South Central			
Arkansas	1,843	2,264	2,435
Louisiana	1,294	1,663	1,807
Texas	1,745	2,168	2,320
Pacific			
California	1,111	1,389	1,518

Note: *A*. Underenumeration of deaths was assumed to be 30% of the total deaths. *B*. Underenumeration of deaths was assumed to be 50% of the total deaths.

Source: Table II-7.

the refined birth ratio was changed but slightly even when it was assumed that the underenumeration of deaths was as much as 50%.

2. *Trend of Mortality, 1800-1860*

Some demographers tend to take it for granted that mortality has been declining continuously, if not steadily, since the early part of the nineteenth century. For example, Thompson and Whelpton stated that in a century since the first life table was

computed for Massachusetts "the crude death rate has been reduced by about 60 per cent; from a high of 27.8 per 1,000 in 1789 there was a falling off to 21.4 in 1855 and to 11.4 in 1931." [18] In a chart in their book showing the trend of mortality, the death rates for years between 1790 and 1855 are simply interpolated on a straight line basis.

There are two reasons to doubt the appropriateness of their statement. First, the reliability of the figure for 1789 is questionable. The figure was based on the life table of Wiggleworth, which was constructed from death records alone. It is true that Wiggleworth made an adjustment allegedly to allow for the effect of the age-distribution of population but, since (1) the age-distribution he used was such a rough one as "under 16" and "16 and upwards," and (2) he did not take into account the migration of population,[19] it is hardly warranted to place much confidence on the figures of the expectation of life.

Second, even if the expectation of life became somewhat longer between 1789 and 1850, it does not necessarily mean that mortality rate declined continuously over the whole period. On the contrary, a rather sharp decline during the first few decades may have been partly offset by a rise during the latter half of the period.

It is well known that this was exactly what happened in England. A sharp decline in mortality which set in around 1780 continued until 1810 and then the trend was reversed. A new downward trend did not start until the 1870's.[20] A similar increase in mortality was reported for France between 1817-32 and 1861-67,[21]

[18] Warren S. Thompson and P. K. Whelpton, *Population Trends in the United States*, New York 1933, p. 230. For a similar opinion, see Donald J. Bogue, *The Population of the United States*, with a Special Chapter on Fertility by Wilson H. Grabill, Illinois 1959, p. 174.

[19] Edward Wiggleworth, "A Table Shewing the Probability of the Duration, the Decrement, and Expectation of Life, in the State of Massachusetts and New Hampshire," *Memoires of the American Academy of Arts and Science*, 1793, 2, pp. 131-135.

[20] G. Talbot Griffith, *Population Problems of the Age of Malthus*, Cambridge 1926, p. 36; M. C. Buer, *Health, Wealth and Population in the Early Days of the Industrial Revolution*, London 1926, p. 224; Richard Harrison Shryock, *The Development of Modern Medicine: An Interpretation of the Social and Scientific Factors Involved*, London 1948, p. 178.

[21] Joseph J. Spengler, *France Faces Depopulation*, Durham, N. C. 1938, p. 44; Louis I. Dublin, Alfred J. Lotka, and Mortimer Spiegelman, *Length of Life*, Rev. Ed., New York 1949, pp. 349, 364. In France only the child mortality rate increased. Due to the reduction in the adult mortality rate, the life expectancy at age 0 changed little between these two periods.

for Sweden between 1841-45 and 1856-60, and for Norway between 1821-30 and 1831-40.[22] These increases of mortality rate were believed to be due to the intense social changes accompanying the progress of industrialization, such as the dislocation of the masses from land and the consequent concentration of people in urban areas. A similar socio-economic change was taking place, albeit with less severity, in the United States during the few decades preceding the Civil War. Therefore we may at least suspect that a similar movement of the mortality rate may have taken place in the United States.

TABLE III-6

CRUDE DEATH RATE FOR LARGE CITIES:[a]
UNITED STATES, 1804-1900

	per 1,000		per 1,000
1804–1809	26.2	1804–1825	24.6
1810–1819	22.7	1825–1850	25.7
1820–1829	25.8	1850–1875	26.9
1830–1839	26.2	1875–1900	21.9
1840–1849	25.2		
1850–1859	29.3		

Note: *a*. Cities included: New York City 1804-; Boston 1811-; Philadelphia 1820-42, 1846-55, 1860-91; Lowell, 1836-; Chicago 1843-; Rochester 1845, 1847-49, 1856-67, 1877-; Brooklyn 1847-; San Francisco 1851-63, 1867-; Pittsburgh 1853-; Providence 1854-; Savannah 1854-; Newark 1854, 1859-61, 1863-64, 1866-; Baltimore 1860-.

Source: John K. Gore, "On the Improvement in Longevity in the United States during the Nineteenth Century," *Proceedings of the Fourth International Congress of Actuaries in New York, 1903*, 1904, 1, p. 33.

Until Massachusetts started the modern system of registration no record of deaths on a state level existed. All that we have are records kept by cities and towns. Perhaps the most comprehensive compilation of these local records was made by John K. Gore in his report before the Fourth International Congress of Actuaries. He computed for each year since 1804 the average number of deaths per 1,000 population in cities for which mortality records were available. (See Table III-6.) Between 1804 and 1810 the death rate was computed only for New York. Boston was added in 1811 and then Philadelphia in 1820, Lowell

[22] *Ibid.*, pp. 347-350.

in 1836, Chicago in 1843 and so on. Thus, the mortality trend presented can be said to be representative of the experience of larger cities in the United States.

The death rate fluctuated widely from decade to decade, and there seems to be no definite trend. Of course, if we compute quarter-century averages as Gore did, we get a slight upward trend from the first to the third quarter-century (See the right side of the Table), but in view of the wide fluctuations the significance of such a slight increase may be questioned.

TABLE III-7

CRUDE DEATH RATE IN NEW YORK, BOSTON, BALTIMORE, LOWELL AND SOUTHAMPTON, 1804-1865.

	New York	Boston	Baltimore[a]	Lowell	Southampton
1804–10	25.3				14.3[d]
1811–20	25.5	20.9	28.9[b]		16.7[d]
1821–30	26.5	20.5	24.6		13.3[d]
1831–40	29.5	21.5	23.2	17.8[d]	19.1[d]
1841–50	31.3	25.4[c]	21.4	22.2[d]	18.5[d]
1851–60	34.8	24.6	26.1	18.9[d]	24.6[d]

Note: *a*. Deaths of those dying at the almshouse and at the almshouse hospital, the quarantine hospital, and the Sydenham Hospital are not included. *b*. 1812-20. *c*. 1841-45. *d*. Ten year average centering on the last year of each decade.

Source: New York, New York City, *Annual Report of the Board of Health of the City of New York*, New York 1907, p. 696; Boston, 1811-40, Lemuel Shattuck, *Report to the Committee of the City Council Appointed to Obtain the Census of Boston for the Year 1845*, Boston 1846, p. 132, 1841-60, Boston, Registry Department, *Annual Report for the Year 1900*, Boston 1901, pp. 51, 53; Baltimore, William Travis Howard, Jr., *Public Health Administration and the Natural History of Disease in Baltimore, Maryland, 1797-1920*, Washington 1924, pp. 174, 521; Lowell, Lowell (Mass.), *Annual Report of the City Physician and Superintendent of Burials of the City of Lowell for the Year 1880*, Lowell, Mass. 1881, p. 6, Lowell (Mass.), *Annual Report of the Births, Marriages and Deaths for the City of Lowell for the Year 1880*, Lowell, Mass. 1881, p. 12; Southampton, Wendell Hubbard Bash, *Factors Influencing Family and Community Organization in a New England Town, 1730 to 1940*, unpublished Ph. D. dissertation, Harvard University, June 1941, pp. 142-143.

It may be suspected that the addition of cities from time to time may have affected the general trend significantly. If the death rate in smaller cities was lower than that in larger cities, the average death rate may have been pulled down each time a new and smaller city was added to the list, and the upward trend in mortality within each city may have been covered up.

To see whether this was the case, mortality records of a few cities and towns were examined separately.

Table III-7 shows that the fall in the average death rate in Table III-6 between 1804-1809 and 1810-1819 is only apparent; the fall was created by the addition, in the latter decade, of Boston with a lower death rate. The death rate in New York City which was represented in both decades increased slightly. The addition of Lowell in 1836 with a lower-than-average death rate also tended to mask the upward trend in the crude death rate, although the effect may not have been very great in this case since the relative smallness of the population of Lowell compared with the total population of New York, Boston, and Philadelphia. If the fall between 1804-1809 and 1810-1819 is taken to be only apparent, the general trend of the average death rate in Table III-6 will appear to have been clearly upward since the decade of 1810-1819.

The death rate within each city, except Baltimore, where the enumeration of deaths was admittedly incomplete, increased, particularly after the decade of 1821-1830. Of course there is a possibility that the records became more complete in later years but, at least about Boston it was claimed "that all, or very nearly all, the deaths that have taken place in the city are recorded" since "heavy penalities were imposed for burying without permission." [23]

Another piece of evidence which suggests that the death rate may have increased in cities during the few decades preceding the Civil War is the table of the expectation of life constructed by Russell and Lucia for the town of East Haven in 1773-1822. The table is reproduced in Table III-8 along with a comparable table for New Haven in 1909-11 prepared by Louis I. Dublin. The expectation of life scarcely improved even at ages 5-6 and 10-11. At ages higher than that there was a considerable deterioration of life expectancy. In view of the marked improvement in mortality at younger ages in American cities during the last half of the nineteenth century,[24] we are inclined to say that life expectancy must have become shorter during the first half of the nineteenth century.

[23] Lemuel Shattuck, "On the Vital Statistics of Boston," *The American Journal of the Medical Sciences*, April 1841, New Series 1, p. 374.

[24] Accoridng to Gore, the mortality rate for children aged 5-9 in larger United States cities fell from 14.1 per 1,000 in 1850-54 to 5.9 per 1,000 in 1895-1900. Cf. Gore, *loc. cit.*, pp. 36-40.

The evidence examined shows that the salubrity of city life may have deteriorated during the several decades before the Civil War. This could be expected as a natural consequence of the rapid increase of urban population at a time when large scale public health measures were yet to be introduced. By the middle of the century, many persons became aware of the deleterious effect of urban congestion on health, and efforts to tackle the problem began to be made in several cities.[25]

TABLE III-8

EXPECTATION OF LIFE AT GIVEN AGES, FOR EAST HAVEN, 1773-1822, AND NEW HAVEN, 1909-1911

Age	East Haven (1773-1822)	New Haven (1909-1911)
5–6	52.3	54.0
10–11	49.0	49.6
20–21	41.4	41.0
30–31	36.4	33.1
40–41	30.5	25.8
50–51	22.9	18.9
60–61	16.1	12.9

Source: Frances E. Russell and Eschscholtzia L. Lucia, "A Comparison of the Mortality in a New England Colonial Town with That of Modern Times," *The American Journal of Hygiene*, May 1929, 9, p. 522.

If city mortality increased, we might presume that the overall mortality in the United States may have increased more rapidly, since the proportion of urban population was increasing throughout the period.

According to the life table for the United States in 1830 prepared by Jaffe and Lourie the expectation of life at age 5 was 52.4 for whites. Twenty years later, according to Paul Jacobson the expectation of life at the same age was 50.1 for white males and 51.2 for females.[26] The difference in the expectation of life,

[25] Cf. Shattuck, *loc. cit.*, p. 383; New York City, Board of Health, *Annual Report of the Resident Physician of the City of New York for 1865*, p. 7; Edgar Sydenstricker, *Health and Environment*, New York 1933, p. 188; Whipple, *op. cit.*, Vol. I, pp. 285-287; and Bernhard J. Stern, *American Medical Practice in the Perspectives of a Century*, New York 1945, p. 3.

[26] Paul H. Jacobson, "An Estimate of the Expectation of Life in the United States in 1850," *The Milbank Memorial Fund Quarterly*, April 1957, 35, pp. 199, 201. The figure for the expectation of life for the Jaffe-Lourie table was computed by Mortimer Spiegelman.

however, does not seem large enough to be significant in view of the fact that the methods of construction of the two tables were not identical. The Jaffe and Lourie table was based on the mortality experiences of many towns mostly in New England and some in the Middle Atlantic Division, while Jacobson's table was based on the arithmetic mean of the age-specific death rates in Massachusetts and Maryland in 1850.

Our last resort is again the census records of population. If population is closed, the trend in mortality may be ascertained by computing successive ratios of population 10 years of age and older to the total population in the previous census. As the population is not closed, we have to subtract from the former figure the number of net immigrants during the decade who have survived to be 10 years of age and older at the census date.

Computations were carried out only for the decades 1820-30, 1830-40, and 1850-60. The period before 1820 was omitted because the statistics of immigration were extremely unreliable before 1820. The decade 1840-50 was left out because of the three major territorial expansions in this decade.

The number of foreign passengers arriving at American ports was reported yearly by the State Department beginning in 1820. Aside from omissions and errors in the reports, the reported number of foreign passengers was different from the number of immigrants in several ways.

First, the reported number of passengers included only steerage passengers and not cabin passengers. In our computation, an allowance of 8% of the reported number was made for cabin passengers, following Willcox.[27] Secondly, some of the foreign passengers were transient visitors. These, estimated at 2% by Willcox, had to be subtracted from the number of total passengers.[28] Thirdly, overland immigrants from Canada and later from Mexico were not included. We assumed that the ratio of Canadian immigrants to British immigrants was the same in 1820-1840 as in 1817 for which the estimate by Adam Seybert is available.[29] For 1850-60 it was assumed that the ratio of Canadian immigrants to British immigrants was the same as the ratio of the Canadian-born to the British-born living in the United States

[27] Walter F. Willcox ed., *International Migrations,* Vol. II, New York 1931, p. 86.
[28] *Ibid.*, p. 648.
[29] Adam Seybert, *Statistical Annals: Views of the Population, Commerce, Navigation, Fisheries . . . of the United States of America,* Philadelphia 1818, p. 29.

in 1860. As for Mexicans, immigration was assumed to be negligible before 1840 and the number of immigrants during the decade 1850-60 was estimated from the records of nativities in 1850 and in 1860 assuming an average annual death rate of 20 per 1,000 for those Mexicans living in the United States in 1850.

Second, there was a stream of out-migrants, i. e., American emigrants and returning foreign migrants. The former was likely to be negligible but the latter would have to be taken into acount. The ratio of departure of immigrants to arrivals was 17% in 1878-1897 and 30% in 1908-1914. Later it became still larger until the departures became more numerous than arrivals during the depression period of the 1930's. In view of the trend and also in view of the fact that the number of immigrants was increasing more rapidly during the first half of the century than in later years, it may be concluded, following Kuznets and Rubin,[30] that the ratio of immigrant departures to arrivals was not more than 10% for our period.

White population in Florida which was not included in the census of 1820 was enumerated in 1830. It was assumed that the overall rate of increase of white population in this area during 1820-30 was the same as during 1830-40, and, on this assumption, the white population in 1820 was estimated.

For the sake of simplicity, all the immigration and emigration were assumed to have taken place at a time when half of the total immigrants of each decade had arrived, namely, 2.8, 3.5, and 6.3 years, respectively, before the census dates of 1830, 1840, and 1860. It was also assumed that the age-distribution of "net immigrants" was the same as that of passengers arriving.

To estimate the number of immigrants who survived to contribute to the number of total population 10 years of age and older at the end of a decade, the age-specific death rate for Massachusetts in 1855[31] was applied to the estimated number of net immigrants who would have been 10 years of age and older at the end of the decade. The estimated number was then subtracted from the number of whites 10 years of age and older at the end of the decade. The difference between what was left—the estimated number of survivors (p_1) at the end of the decade—and the total white population at the beginning of the decade

[30] Simon Kuznets and Ernest Rubin, *Immigration and the Foreign Born*, New York 1954, pp. 2-3.

[31] Elliott, *loc. cit.*, p. 59.

(p_0) is the estimated number of deaths, within the decade, of the white population which was present at the beginning of the decade. The average death rate (d) per year was computed by $p_1 = p_0(1-d)^{10}$.

The result of the computation is summarized in Table III-11. The average death rate [32] appears to have increased from 1820-30 to 1850-60.

Changing age-distribution of the population may have played a part in producing the apparent increase of mortality. To see whether this was the case, the death rates were standardized to the age-distribution in 1860. The standardized death rates were 12.5, 14.0, and 14.2 per 1,000 respectively for 1820-30, 1830-40, and 1850-60. The upward trend, though somewhat weakened, still remains.[33]

Many assumptions made in the course of the computation may seem to be rather arbitrary but in most cases an error of fairly large magnitude in an assumption will result in a slight change in the figure for the death rate. For example, the estimated number of white inhabitants in Florida in 1820 was 12,095 compared with the enumerated total population of 7,861,937 and an error as large as 50% in the estimate of the population in Florida would result in an error of less than .01 in the death rate. Likewise, if the age-specific death rate of immigrants was higher by 30% than that in Massachusetts in 1855, the estimated death

[32] The average death rate is the average death rate for a cohort of population during a ten year period. It should not be confused with the crude death rate, which is higher.

[33] The standardized death rates for 1820-30 and 1830-40 were computed according to the following formula; $d_t \div \dfrac{\frac{\sum p_t q^{\#}}{\sum p_t}}{\frac{\sum p_{1860} q^{\#}}{\sum p_{1860}}}$, where d_t is the average death rate per year during a decade ending in year t, p_t the number of persons belonging to each age-class in year t, and $q^{\#}$ age-specific death rate computed in the following way from the Elliott's life table for Massachusetts in 1855.

For an age-class 10-15 or older, the death rate for the age-class five years older was estimated on a straight line basis and this was assumed to be the average death rate for the former age-class during the intercensal years. The straight line method could not be applied for age-classes 0-4 and 5-9 due to the curvature of the curve of age-specific mortality in these age-classes. For the latter, the average of death rates for age-classes 5-9, 10-15, and 15-20 with a double weight for the second class was used. For the former, the average death rate was computed from the average of 10-year survival ratios for each age. It may be written as $1 - \frac{1}{5}\sum_{x=0}^{4} \frac{l_{x+10}}{l_x}$, where l_x is the number of life-table survivors at the beginning of age x.

rate of the white population would have to be changed respectively by less than 0.1, 0.1, and 0.2, for the decades 1820-30, 1830-40, and 1850-60.

The only assumption which might change the result considerably is the assumption about the ratio of emigrants to immigrants.

TABLE III-9

ESTIMATED AVERAGE DEATH RATE OF THE WHITE POPULATION IN THE UNITED STATES, 1820-30, 1830-40, AND 1850-60

	1820-30	1830-40	1850-60
(1) Alien passengers arriving at U. S. ports	137,243	552,000	2,707,624
(2) Immigrants to the U. S.	160,053	643,742	2,997,340
(3) Emigrants from the U. S. .1 × (2)	16,005	64,374	299,734
(4) Net immigration (2)-(3)	144,048	579,358	2,697,606
(5) Net immigration of those who would have been 10 years of age and older at the end of decade	130,368	516,944	2,518,107
(6) Surviving net immigration, 10 years of age and older	126,355	497,396	2,362,516[a]
(7) White population 10 years of age and older at the end of decade	7,104,330	9,704,463	19,311,831
(8) Survivors at the end of decade from the total white population at the beginning of decade (7)-(6)	6,977,975	9,207,067	16,949,325
(9) Total white population at the beginning of decade	7,874,032[b]	10,532,060	19,553,068
(10) Estimated average death rate per year (per 1,000)	12.2	13.8	14.2
(11) Standardized average death rate per year (per 1,000)	12.5	14.0	14.2

Note: *a.* 15,372 surviving Mexican immigrants were added at this stage. *b.* The estimated white population in Florida of 12,095 is included.

Source: U. S. Censuses. Cf. pp. 92-94.

The ratio of .10 was used temporarily, but it may be more proper to allow an upward trend for this ratio. If we assume that the ratio was .00 in the decade of 1820-30 and .15 for the 1870's and that the ratio increased in an arithmetic progression between these two decades, the upward trend of the death rate will be weakened. Instead of 12.5, 14.0, and 14.2, the standardized death

rates will be 12.7, 14.4, and 14.0 respectively, for 1820-30, 1830-40, and 1850-60.

Summing up the foregoing, it might be said that it is doubtful that the downward trend of mortality during the last half of the nineteenth century was the continuation of a similar trend during the first half of the century. Though the lack of reliable data can allow us only to conjecture, it is likely that the death rate increased somewhat during the few decades preceding the Civil War. Where among different age-groups the incidence of the increase fell most heavily, if indeed there was an increase, we can not tell from the available data. But it seems likely, judging from what happened in Europe, that the mortality of young children increased more rapidly than the mortality of adults.

If this is true, the decline in the ratio of children, either under 10 or under 5 years of age, to women of child-bearing age overstates the decline in fertility during the few decades before 1860, although it is impossible that all of the large decline in the ratio of children to women can be explained by the increase in child mortality.[34] About the trend in mortality during the first few decades of the nineteenth century we know very little. But in view of the rather slow progress in urbanization before 1830,[35] the increase in mortality, if there was an increase at all, in these decades must have been small.

3. *Some Estimates of Birth Rates*

The survey of information on mortality revealed that the mortality statistics before the Civil War was very fragmentary and unreliable. Consequently, only rough estimates of births and birth rates can be made based on several assumptions.

For the middle part of the century, reliable life tables are available only for a few localities. The age-specific death rate for Msasachusetts in 1855 was most likely considerably higher than that for the whole nation, because Massachusetts was one of the most urbanized states then. Jacobson, realizing this, tried to construct a life table for the United States by averaging the age-specific death rates for Massachusetts and for Maryland.[36] Though

[34] See the next section.
[35] Cf. Table V-2.
[36] Jacobson, *loc. cit.*, p. 197.

this was an improvement, he neglected the fact that Maryland was also one of the most urbanized states at that time, ranking third in the proportion of urban population and bettered only by Rhode Island and Massachusetts. Consequently, Jacobson's estimate of mortality would also be too high.

Having no better estimate of mortality, we estimated the number of births in 1850, utilizing Jacobson's United States life table for 1850 [37] and another life table which was based on Jacobson's table and on the United States Census of 1850. The latter table was constructed on the assumption that the degree of underenumeration of deaths in the census of 1850 was the same in Maryland and Massachusetts, on one hand, and the rest of the United States, on the other. The age-specific death rate in Jacobson's table was divided by the ratio of the average of death rates for children under 10 in Massachusetts and Maryland as reported by the Census of 1850 to the comparable death rate for the whole of the United States. Probably, the enumeration of deaths in the 1850 Census was considerably more complete in Massachusetts and Maryland than in the rest of the country; for the number of persons under 10 years of age in a life-table population, $\sum_{x=0}^{9} L_x$, for the life table constructed according to the latter method is even, though slightly, larger than $\sum_{x=0}^{9} L_x$ for Glover's United States Life Table for white females in 1901 (853,340 as opposed to 835,787 [38]). The real death rate for the United States is likely to have been considerably higher than that in the modified Jacobson's table and, hence, the birth rate computed according to the table should be viewed as the lower limit of the actual birth rate.

To estimate the number of births, first, the number of children under 5 was increased by 5 per cent in order to allow for underenumeration; the number of children aged 4-9 was left unchanged. Then, the rate of increase of yearly births (r) attributable to a cohort of population which resided, or would have resided if alive, in the United States in a census year (1850) was estimated on an assumption that it is the same as the rate of increase of women of child-bearing age [39] belonging to the same cohort of popu-

[37] *Ibid.*, p. 198.

[38] U. S. Bureau of the Census, *United States Life Tables: 1890, 1901, 1910, and 1901-1910*, by James W. Glover, Washington 1921, p. 70.

[39] Ages 15-44.

lation. Thus, r was computed from, $\sum_{x=15}^{44} W_x = \sum_{x=20}^{49} W_x \frac{l_{x-5}}{l_x} (1+r)^5$, where W_x is the number of women aged x at a census date (in this case, 1850), and lx the number of life-table survivors at the beginning of the xth year. Finally, the number of births (B) in the census year (1850) was estimated from the corrected number of children under 10 years of age in the census year ($\sum_{x=0}^{9} C_x$) according to the following formula. $B = \frac{\sum_{x=0}^{9} C_x l_0}{\sum_{x=0}^{9} L_x (1+r)^{-x}}$.

TABLE III-10

CRUDE BIRTH RATES IN WESTERN EUROPE, 1845-50, CANADA, 1841-51,[a] AND AUSTRALIA, 1860-62

	per 1,000
Belgium	28.6
Denmark	30.7
England and Wales	32.8
Finland	35.4
France	26.7
Germany	35.8
Holland	31.7
Norway	30.9
Sweden	30.9
Canada	43.1
Australia	42.6

Note: *a*. Estimated by Keyfitz from census population data.

Source: Western Europe, Robert R. Kuczynski, *The Balance of Births and Deaths*, Vol. 1, New York 1928, p. 7; Canada, Nathan Keyfitz, "The Growth of Canadian Population," *Population Studies*, June 1950, 4, p. 55; and Australia, W. D. Borrie, *Population Trends and Policies*, Sydney 1948, p. 40.

The crude birth rate in 1850 is 42.9 per 1,000 if the Jacobson table is used and 38.4 if the modified Jacobson table is used. Even the lower figure is considerably higher than the birth rate of any Western European countries at that time and the higher figure is in line with those of Canada and Australia. (See Table III-10.)

Our lack of knowledge of mortality in the United States in the first few decades of the nineteenth century makes the estimate of the birth rate at the beginning of the century still less reliable.

However, it is likely that the estimate by Thompson and Whelpton (55.0 [40] per 1,000 in 1800), which used the death rate interpolated from Wiggleworth's life table for Massachusetts and New Hampshire in 1787 and the Massachusetts Life Table for 1855 and which ignored the influx of immigrants, was on the high side. If Jacobson's life table for the United States in 1850 is used, the crude birth rate becomes 52.9 and, if the modified Jacobson table is

TABLE III-11

ESTIMATED CRUDE BIRTH RATE[c] FOR THE WHITE POPULATION: UNITED STATES, 1800-1860

	Estimate *A*[a] (per 1,000)	Estimate *B*[b] (per 1,000)
1800	52.9	47.6
1810	52.7	47.3
1820	51.1	45.9
1830	49.8	44.7
1840	47.9	43.0
1850	42.9	38.4
1860	42.1	37.7

Note: *a*. Estimate *A* is based on Jacobson's United States life table for 1850. *b*. Estimate *B* is based on the modified Jacobson's life table. *c*. The method of estimation is explained in pp. 97-98. The proportion of children under 5 years of age among children under 10 years of age in 1800, 1810, and 1820 was assumed to be the same as in 1830. The rate of increase of births attributable to population which resided, or would have resided, in the United States at a census date before 1830 was assumed to be equal to the rate for 1830.

Source: Population by age, U. S. Censuses. Cf. Appendix III; life table, Jacobson, *loc. cit.*, p. 198. Cf. p. 97 of this chapter.

used, the birth rate becomes 47.6. The actual rate was probably somewhere between 47.6 and 52.9. Blodget's estimate of 52-53 for 1790-1805 and Lotka's estimate of 50.8 for 1790-1800 [41] may not be much off the mark.

Between 1800 and 1860, even if we use Jacobson's life table for the United States in 1850 for estimating the birth rate in 1860 and the modified Jacobson's table for estimating the birth rate in 1800—the most unfavorable assumption for the hypothesis of a fall in the birth rate—the crude birth rate falls from 47.6 to 42.1 (See Table III-11.) Thus, it is highly unlikely that the large

[40] Thompson and Whelpton, *op. cit.*, p. 263.
[41] Cf. pp. 38, 39 in Chapter I.

decline in the birth ratio could be completely, or even largely, explained by a rise in mortality.

4. *Summary*

For the period 1800-1860 few data are available on mortality. The registration records of a few states for the last decades of the period, records of deaths kept by a handful of cities and towns, some local genealogies, and mortality statistics in the United States Censuses of 1850 and 1860, are all that we have. Among these, only mortality statistics in the United States Censuses of 1850 and 1860 contain information on the relative levels of mortality in all states and territories in the United States.

The census statistics of mortality are defective as indicators of the relative levels of mortality of states and territories on two grounds; (1) the mortality experience for only one out of ten years was represented and (2) many of the deaths were left unrecorded. To see whether the relative levels of mortality as reported by the Census of 1850 are at all plausible, several tests were conducted. We found that child mortality as reported by the Census tended to be higher where the ratio of children under 1 to children under 5 was larger, where population density was higher, where the proportion of persons employed in non-agricultural pursuits was larger, and where the proportion of urban population was larger. We also found that the crude death rate was higher where there were relatively more child deaths compared with deaths of persons aged 50-79. All these results, some of them interrelated, are what we would expect, if the relative levels of mortality shown by the enumerators' returns represent the relative levels of actual mortality.

Thus, it is likely that, in the middle of the nineteenth century, mortality for white children under 10 years of age was higher in the urbanized states in the New England and Middle Atlantic regions, as well as in the states in the lower Mississippi Valley. It was lower in the South outside the Mississippi Valley and in the less urbanized states in the West. The refined birth rates, or the numbers of yearly births per 1,000 women of child-bearing age, in the former group of states and territories were likely to be higher than the refined birth ratios show; and the birth rates in the latter group were likely to be lower than the birth ratios indicate.

However, the relative levels of the birth ratios seem to express not so much the relative levels of child death rates as the relative levels of birth rates.

It is well known that mortality declined during the last half of the nineteenth century. What happened during the first half is much less certain. The increase in mortality in industrializing European countries, the increase or stagnation of the death rate in cities coupled with the progress of urbanization in the United States and the analysis of census population statistics and immigration records suggest but do not prove that the death rate may have increased somewhat in this country during the few decades preceding the Civil War. If this was true, the fall in the birth ratio during these few decades overstates the fall in fertility. However, it is highly unlikely that the large decline in the birth ratio could be completely, or even largely, explained by a rise in mortality.

The crude birth rate in the United States in the period, 1800-1860,—around 50 per 1,000 in 1800 and approximately 40 per 1,000 in 1860—was higher than in Europe and probably in line with the birth rate in Canada.

Chapter IV

DEMOGRAPHIC EXPLANATIONS OF BIRTH RATES

In preceding chapters it was shown (1) that there were wide differentials in the birth rates of different states and territories, and (2) that the trend in the birth rate was continuously downward in the United States and also within each state. In this chapter we evaluate the part different age-distributions and, particularly, different marriage customs played in creating these differentials and trends in the birth rates.

No explanation is needed for the concept of the "age-distribution of population." "Marriage custom" is a summary phrase by which is meant the totality of propensities or probabilities to marry, to divorce, to be widowed, and to remarry; it is not concerned with intramarital sexual behavior. Since the probability for a married couple to have a child is primarily a function of the age of the wife, and the average number of children a function of the age at marriage of the wife,[1] only the marriage customs of women are taken into account in this chapter.

The effect of these two demographic variables on the measure of fertility, such as the refined birth rate or the refined birth ratio, is quite different. *So far as fertility is concerned*, differentials and trends in the birth rate or in the birth ratio which are caused by different or changing age-distributions are only apparent. However, the differentials and trends in the birth rate caused by different or changing marriage customs represent differentials and trends in the fertility of a population group. Therefore, when we are interested in the levels and trends of fertility, we would like to remove the effect of age-distribution but not the effect of

[1] According to the study of J. C. Dunlop on the fertility of Scots as reported in the Census of 1911 (James Crawford Dunlop, "The Fertility of Marriage in Scotland: A Census Study," *Journal of the Royal Statistical Society*, February 1914, 77, p. 268) the average number of children per completed family (c) can be expressed by the following function, $c = 14.889 - 0.332w - 0.028h$, where w and h are the ages at marriage of wife and husband.

marriage customs. Both the marital fertility and the fertility of women in general are of interest for students of demography.

1. *Marriage Customs and Birth Rates*

In the days of Malthus it was generally believed that the level of birth rate depended above all on the average age at marriage and the proportion of persons who eventually married. But how much was the former affected by the latter? One obvious way to answer this question is to apply the age-specific marital fertility rate to several hypothetical marriage customs. Per Goran Ohlin, applying this method to the Swedish data for 1750-1800, demonstrated that a lowering in the average age at marriage of women by one year, from 26 to 25 or from 25 to 24, would raise crude birth rate, *caeteris paribus*, by 2.4.[2]

TABLE IV-1

AGE-SPECIFIC MARITAL FERTILITY RATE FOR SWEDEN, 1776-1800, AND EXPECTED AVERAGE NUMBER OF CHILDREN FOR COMPLETED FAMILIES BY MARRIAGE-AGE

Age	Fertility rate, Sweden, 1776-1800 (per 1,000)	Expected average number of children for a wife marrying at the beginning of each age class
15–19	522	10.3
20–24	467	7.5
25–29	382	5.4
30–34	323	3.5
35–39	224	1.9
40–44	121	0.8
45–49	29	0.1

Source: H. Gille, " The Demographic History of the Northern European Countries in the Eighteenth Century," *Population Studies*, June 1949, 3, p. 31.

Another way of answering the question is to estimate from the table of age-specific marital fertility rate the average numbers of children for completed families with wives marrying at different ages. An example using the Swedish data is shown in Table IV-1.

[2] Per Goran Ohlin, *The Positive and the Preventive Check: A Study of the Rate of Growth of Pre-Industrial Populations*, unpublished Ph. D. dissertation, Harvard University, September 1955, p. 110. The variables kept constant were the incidence of marriage, or percentage of women ever-marrying, the dispersion of marriage-ages, specific death rate and specific marital fertility rate. The crude birth rate computed is based on a stationary population.

The expected average number of children for a woman marrying at age 30 is less than half that for a woman marrying at 20 and only one third that for a woman marrying at 15.

These examples show dramatically how important the effect of marriage-age on the crude, or for that matter the refined, birth rate and the average number of children could be. It may be argued, however, that the probability of a child being born does not only depend upon the age of the wife but also upon the duration of the marriage. For example, for a fecund wife who has been married for 15 years and has had five children the probability of having another child may be smaller than for a newly-wedded fecund wife of the same age. This is the case with the Western European cultural area in the twentieth century where families are to a considerable extent a matter of planning.[3] But for the period before 1860, it may be said that the probability of having another child was largely independent of the duration of marriage.[4]

Even in post-Malthusian years, the average number of children was much greater for a wife who married earlier in life. Three examples, one each for the United States, Scotland, and New South Wales, are shown in Table IV-2. The data for Australia and Scotland were older than the American ones and, consequently, the number of children for the former is larger and declines faster than that for the latter as the age at marriage increases. In the cases of Australia and Scotland, the decline of the number of children as the age at marriage increases is almost as fast as in the example in Table IV-1.

Historically the most notable case in which a change in marriage customs affected the birth rate is that of Ireland after the famine.[5] Aside from this, we have little evidence to indicate that a change in marriage customs has dramatically affected the birth rate in a European country, although there are several instances in which a difference in marriage customs led to a small difference in the birth rate. For example, the increase of the English birth rate during the eighteenth century is believed to have been caused by a change in

[3] Cf. Chapter 9 in Wilson Grabill, Clyde V. Kiser, and Pascal K. Whelpton, *The Fertility of American Women,* New York 1958.

[4] Ohlin, *op. cit.*, p. 101.

[5] United Nations, Department of Social Affairs, Population Division, *The Determinants and Consequences of Population Trends*, Population Studies No. 17, New York 1953, p. 72; A. M. Carr-Saunders, *World Population*, Oxford 1936, pp. 90-92.

marriage customs.[6] The decrease of the age at marriage in Ireland during the last half of the eightenth century and the early decades of the nineteenth century is also said to have been the cause of an increase in the birth rate.[7] Cross-sectionwise some of the international differences in birth rate during the first half of the nineteenth century or earlier are attributed to differences in marriage

TABLE IV-2

AVERAGE NUMBER OF CHILDREN EVER BORN PER WOMAN WHO HAS PASSED THE CHILD-BEARING AGE, BY WIFE'S AGE AT MARRIAGE, IN THE UNITED STATES, SCOTLAND, AND NEW SOUTH WALES

Wife's age at marriage	United States[a]	Scotland[b]	New South Wales[c]
15–19	5.1[d]	9.0[h]	9.9
20–24	3.2[e]	7.0[h]	8.4
25–29	2.2[f]	4.9[h]	6.4
30–34	1.3	3.2[h]	4.6
35–39	.6	1.6[h]	2.9
40–44	.3[g]	.5[h]	1.4

Note: *a*. For women 45-48 years old in 1940. *b*. For women, alive in 1910, who had lived through their period of child-bearing. *c*. For women who were married between 1856 and 1860. *d*. Under 18 years. *e*. 20 and 21 years. *f*. 25 and 26 years. *g*. 40 years and over. *h*. 17, 22, 27, 32 and so on.

Source: United States, Conrad Taeuber and Irene B. Taeuber, *The Changing Population of the United States*, New York 1958, p. 291; Scotland, James Crawford Dunlop, "The Fertility of Marriage in Scotland: A Census Study," *Journal of the Royal Statistical Society*, February 1914, 77, p. 266; New South Wales, T. A. Coghlan, *The Decline in the Birth-Rate of New South Wales and Other Phenomena of Child-Birth*, Sydney 1903, p. 36.

customs. Higher birth rates in Ireland, Finland, and Russia than in other European countries, for example, are believed to have been due to earlier and more general marriages in these countries[8]

The effect of different marriage customs is shown more dramatically in the countries of the New World such as Canada and Australia. As is seen in Table IV-3, the proportion of married

[6] H. J. Habakkuk, "English Population in the Eighteenth Century," *The Economic History Review*, December 1953, Second Series 6, pp. 120-128; Ohlin, *op. cit.*, p. 370; D. E. C. Eversley, "A Survey of Population in an Area of Worcestershire from 1660-1850 on the Basis of Parish Records," *Population Studies*, March 1957, 10, p. 265.

[7] Kenneth Hugh Connell, *The Population of Ireland, 1750-1845*, Oxford 1950, p. 57.

[8] *Ibid.*, p. 39; Ohlin, *op. cit.*, pp. 398, 401-402.

TABLE IV-3

PROPORTION OF MARRIED WOMEN AMONG ALL WOMEN, BY AGE; CANADA, AUSTRALIA, ENGLAND, SWEDEN, AND DENMARK, 1681-1901

COUNTRY:	CANADA			AUSTRALIA[b]		ENGLAND & WALES	SWEDEN		DENMARK
YEAR:	1681[d]	1851[e]	1861[e]	1881	1901	1851	1750	1800	1800
AGE:									
15–19	30.7%	11.6%	6.0%			2.5%	4.4%	2.7%	
20–24	76.9	62.2 (20–29)	54.9 (20–29)	39.5%	28.0%	30.8	27.0	19.4	36.4% (20–29)
25–29	91.7			72.7	56.8	64.3 (25–34)	55.5	50.7	
30–34	94.8	84.5 (30–39)	81.5 (30–39)	86.3	75.2		71.3	67.5	77.2 (30–39)
35–39	89.8			91.3	83.6	75.7 (35–44)	78.9	74.7	
40–44	93.4	80.1[a] (40–59)	80.1[a] (40–59)	93.4			78.6	76.7	82.8 (40–49)
45–49	89.6					70.6[c] (45–54)	74.6	73.9	

Note: *a*. 40-59 years of age. *b*. Proportion of the ever-married. *c*. 45-54 years of age. *d*. For New France. *e*. Nova Scotia is excluded.

Source: Canada, for 1681, Georges Sabagh, "The Fertility of the French-Canadian Women during the Seventeenth Century," *The American Journal of Sociology*, March 1942, 47, p. 688; for other years, Canada, Department of Agriculture, *Census of Canada, 1608 to 1876*, Ottawa 1878; Australia, W. D. Borrie, *Population Trends and Policies*, Sydney 1948, pp. 39, 61; England and Wales, Great Britain Census Office, *Census of England and Wales, 1891*, Vol. IV, *General Report with Summary Tables and Appendices*, London 1893, p. 112; Sweden and Denmark, Gille, *loc. cit.*, p. 26.

women in Canada towards the end of the seventeenth century was far higher than that in Sweden in the middle of the next century, particularly at younger ages. Later, in the middle of the nineteenth century, the difference in marriage customs between the Old and New Worlds was somewhat reduced, as a result of the reduction in the proportion of married women in Canada, but the average age at marriage was still considerably lower in Canada than in Europe. Australian data are for later periods and the proportion of the married was most probably smaller than in previous times. Nevertheless, the age-specific proportion of the married in Australia in 1881 was larger than that in England and Wales in 1851 and than that in Sweden and Denmark in 1800.

The application of the specific marital fertility rate for Sweden in 1766-1800 yields the refined birth rates of 242.8, 172.0, and 155.2 for Canada respectively in 1681, 1851, and 1861. The actual refined birth rates in Canada for these years were respectively 271.9, 204.0, and 182.7,[9] while the average refined birth rate in Sweden around 1800 was 139.1.[10] Thus, 78.1% of the difference between the Canadian refined birth rate in 1681 and the Swedish refined birth rate in 1800 can be explained by the difference in marriage customs and age-distribution. Likewise, 60.6% of the difference between the 1851 Canadian birth rate and the 1800 Swedish rate and 44.1% of the difference between the 1861 Canadian rate and the 1800 Swedish rate are explainable by the differences in marriage customs and age-distribution.

The decrease in the relative importance of marriage customs and age-distribution in explaining the fertility differential between Canada and Sweden is not due to the rise in the specific marital fertility-rate in the former, but due to the rise in the age at marriage and the fall in the incidence of marriage among Canadian women. The ratio of the actual refined birth rate to the standardized refined birth rate (standardized to the Swedish specific marital

[9] The birth rate for 1681 is an average for five years centering on the census date of 1681. Data were taken from Robert R. Kuczynski, *Birth Registration and Birth Statistics in Canada*, Washington 1930, p. 49, and Benjamin Sulte, *Histoire des canadiens-français 1608-1880*, Vol. V, Montréal 1882, p. 88. The last two rates were linearly interpolated from Keyfitz's estimates of the average refined birth rates for 1841-1851, 1851-1861, and 1861-1871, which were based on the census population data. Nathan Keyfitz, "The Growth of Canadian Population," *Population Studies*, June 1950, 4, p. 55.

[10] An average birth rate for 1796-1805. Data were taken from Robert R. Kuczynski, *The Balance of Births and Deaths*, Vol. I, *Western and Northern Europe*, New York 1928, pp. 100-101, and Gille, *loc. cit.*, p. 56.

fertility) which might be called the index of specific marital fertility remained remarkably constant over time (1.12, 1.12, and 1.13 respectively for 1681, 1851, and 1861). This means the fall in fertility in Canada between 1681 and 1861 is wholly explained by the change in marriage customs and age-distribution.

A similar thing can be said about Australia somewhat later. Births per 1,000 *married* women under 45 in New South Wales declined only 1.3% between 1861 and 1881,[11] while the crude birth rate decreased 17.8%.[12] In view of the fact that the average age at marriage became higher, the specific marital fertility-rate may not have decreased at all.

2. *Effect of Changing Marriage Customs on Fertility in the United States*

The data on marriage customs in the United States before 1890 when the Federal Census started to publish information on them, were very poor. There are plenty of descriptive accounts by travellers and local historians of the universal early marriages in the colonial and early Federal periods,[13] but these are too vague or fragmentary to allow one to draw a good picture of the marriage customs in these periods.

The age-specific proportion of single women reported in the United States Censuses since 1890 suggests that the trend in marriage customs was reversed around 1890. As is seen in Table IV-4, the overall proportion of single women has decreased steadily since 1890. However, if we look more closely, we will find that this overall trend is created primarily by the steady decrease in the proportion of single women in younger age groups, which are assigned greater weights in averaging. In older groups, particularly in the age group 65 years and over, the contrary trend can be observed. From this fact some demographers inferred that the proportion of single women must have been increasing until about 1890.[14]

[11] Coghlan, *op. cit.*, p. 4. Marital birth rate started to decline very rapidly after 1881. It was 340.8 in 1861, 336.3 in 1881, and 235.3 in 1901.

[12] Borrie, *op. cit.*, p. 40.

[13] Arthur W. Calhoun, *A Social History of the American Family: From Colonial Times to the Present*, Vol. II, New York 1945, pp. 13-15; Thomas P. Monahan, *The Pattern of Age at Marriage in the United States*, Philadelphia 1951, p. 99.

[14] Carr-Saunders, *op. cit.*, pp. 88-89; Taeuber and Taeuber, *op. cit.*, p. 152.

TABLE IV-4

PROPORTION OF SINGLE WOMEN AMONG ALL WOMEN IN THE UNITED STATES, BY AGE: 1890-1950

AGE	1890	1910	1930	1950
15–19	90.3%	87.9%	86.8%	82.9%
20–24	51.8	48.3	46.0	32.3
25–29	25.4	24.9	21.7	13.3
30–34	15.2	16.1	13.2	9.3
35–44	9.9	11.4	10.0	8.3
45–54	7.1	8.5	9.1	7.8
55–64	5.8	7.1	8.9	7.9
65 & over	5.6	6.3	8.1	8.9
15 & over	31.8	29.7	26.4	18.5

Source: Taeuber and Taeuber, *op. cit.*, p. 150.

TABLE IV-5

PROPORTION OF SINGLE WOMEN 15 YEARS OF AGE AND OVER, BY AGE AND BY SUCCESSIVE BIRTH COHORTS, FOR WOMEN BORN BETWEEN 1835 AND 1934: UNITED STATES

AGE OF WOMEN:	15-19	20-24	25-29	30-34	35-44	45-54	55-64	65 & over
Year of Birth:								
1835–1844	...	...	...	...	...	7.1%	6.6%	6.3%
1845–1854	...	...	...	...	9.9%	7.8	7.1	7.1
1855–1864	...	...	25.4%	5.2%	11.1	8.5	8.4	8.1
1865–1874	90.3%	51.8%	27.5	16.6	11.4	9.6	8.9	9.3
1875–1884	88.6	51.5	24.9	16.1	11.4	9.1	9.0	8.9
1885–1894	87.9	48.3	23.0	14.9	10.0	8.7	7.9	...
1895–1904	87.0	45.6	21.7	13.2	10.4	7.8	...	...
1905–1914	86.8	46.0	22.8	14.7	8.3	...	...	...
1915–1924	88.1	47.2	13.3	9.3	...	...	...	...
1925–1934	82.9	32.3	...	...	...	...	...	...

Source: Table IV-4.

When we reconstruct the Table in such a way as to show the experience of birth-cohorts as they grew older (Table IV-5), we get a clearer picture of the trend of marriage customs. At every comparable age the proportion of single women increases steadily, as we move from older generation to newer, up to the cohort which was born between 1865 and 1874, and decreases after that. Carr-Saunders, who doubted the prevalence of knowledge

of contraception before the Bradlaugh-Besant Trial in 1876, reasoned that this decreasing proportion of married women was the direct cause of the continued decline in the birth rate in this country.[15] Most other demographers, while granting that the decline in the proportion of the married may explain a part of the decline in the birth rate, discounted its importance and sought the major explanation in the reduction of intramarital fertility.[16]

The only way to check the validity of these conflicting statements is to go through the state and local records of marital status. It was Thomas P. Monahan who studied these state and local records most extensively. His conclusion that the marriage customs of the American people have not changed very much since the late colonial period[17] seems to support the opinion of the majority of demographers who think the decline of the birth rate was caused primarily by the reduction of intramarital fertility.

However, there seem to be two major defects in Monahan's analysis. First, in most cases he compared whichever years he had information about in the eighteenth or nineteenth century with 1940, neglecting the fact that the overall proportion of the married has been increasing since 1890. Secondly, he virtually ignored, and sometimes misinterpreted, the effect of a change in the age composition of the population.

Let us illustrate these points. As is seen in Table IV-6 the proportion of the married among all women 16 years of age and older in New Hampshire decreased by 10.6% and the proportion of the married among all women aged 20-69 in Connecticut decreased by 8.8%, between the late colonial period and 1940. From this Monahan concluded "that there was no great change [in marriage customs] from colonial to recent times, especially if one gives adequate emphasis to the changing age-distribution and the possibility that remarriage of widowed persons may have been somewhat greater in colonial times."[18]

His reasoning on the effect of the different age-distribution was peculiar. The proportion of widows among women in a certain age group is larger in an older age group and the proportion

[15] Carr-Saunders, *op. cit.*, pp. 88-89.

[16] For example, Warren S. Thompson, *Population Problems*, New York 1930, p. 116; P. K. Whelpton, "Causes of the Decline in Birth Rates," *The Milbank Memorial Fund Quarterly*, July 1935, 13, p. 249; Taeuber and Taeuber, *op. cit.*, p. 256.

[17] Monahan, *op. cit.*, p. 82.

[18] *Ibid.*, p. 82.

of older women among all women is larger in 1940 than in the colonial period. Therefore, it is correct to say that, if the age-specific proportion of widows remained the same, the decline in the overall proportion of the married overstates the change in marriage customs. But this is only a part of the effect of the changed age-distribution. While the proportion of widows was higher in older ages the proportion of the single was higher in younger ages. Since there were proportionately more younger

TABLE IV-6

PERCENTAGE OF WOMEN BY MARITAL STATUS:
FOR WOMEN 16 YEARS OF AGE AND OVER IN NEW HAMPSHIRE, 1767, 1773, AND 1940;
FOR WOMEN AGED 20-69, IN CONNECTICUT, 1774 AND 1940

	NEW HAMPSHIRE				CONNECTICUT	
	1767[a]	1773[a]	1940		1774[a]	1940
Single	22.6	24.4	26.2	Married	73.5	66.7
Married	66.6	66.8	59.5	Single & widowed	26.5	33.3
Widowed	10.7	8.8	14.3			

Note: *a*. For white women only. Ratios for New Hampshire were estimated by Monahan on an assumption that (1) the proportion of women under 16 years of age among total women was the same as the comparable proportion for men and (2) all the married women were 16 years of age or older.

Source: Monahan, *op. cit.*, p. 81; U. S. Bureau of the Census, *A Century of Population Growth—From the First Census of the United States to the Twelfth, 1790-1900*, by W. S. Rossiter, Washington 1909, pp. 150, 166.

women in the colonial period than at present, the decline in the overall proportion of the married understates the real change in marriage customs. Monahan took the first effect into account and completely neglected the second. Actually, the second effect was likely to be much more important. For, at any time, there were much more women at the very young ages at which the proportion of the single was large than at the very old ages at which the proportion of widows was substantial. The proportion of the married among women aged 20-69 for Connecticut in 1940 standardized for the 1774 age-composition of women is 64.7% while the non-standardized figure is 66.7%. Similarly, the standardized proportion for New Hampshire in 1940 is 56.5% as against the non-standardized figure of 59.5%.[19]

[19] The age-distribution of women was estimated by fitting an exponential curve

The probability of remarriage for a widow may have been higher in colonial times, as Monahan presumes. However, the probability of becoming a widow in thr first place was surely higher then due to higher mortality. This effect might well offset a major part of the first effect, if it does not upset it.

Perhaps the more serious of the errors of Monahan is his neglect of the upward trend in the proportion of the married since 1890. If we take the 1890 figures instead of the 1940 figures for the purpose of comparison with the colonial figures the decline in the proportion of the married will be from 73.5% to 61.5% instead of to 66.7% for Connecticut and from 66.8% to 56.4% instead of to 59.5% for New Hampshire. When the 1890 proportions are standardized for the colonial age distribution, they became still lower, 60.7% and 53.8% respectively for Connecticut and New Hampshire. The changes in the proportion of the married from 73.5% to 60.7% and from 66.8% to 53.8% seem to be anything but small. It should be at least worthwhile to examine the possible effect of the change in the marriage customs of women upon their fertility.

In addition to those already mentioned, similar data on marital status are available for New York in 1825 and decennially thereafter and for Michigan in 1854 and decennially thereafter. For Boston in 1845 and Charleston in 1848, we have detailed statistics of population classified by age and marital status.

For Connecticut, New Hampshire, New York, and Michigan, the age-specific proportion of the married had to be estimated from the overall proportion which was given. For that purpose it was assumed that within the same state the proportion of the nonmarried changed proportionately in different age-classes.[20] This

of the type, $f(x) = ae^{bx} + c$ to the data. For New Hampshire, for which no age breakdown was given in 1773, population data in 1800 was substituted. In fitting the curves, at first the data were plotted on graphs, the average value of the population of each age-class being taken to represent the mid-point of the age-class except in the case of the age-class 20-69 in Connecticut in 1774. In this case the age-class was too broad to allow the use of the average and, therefore, an integral of a quadratic curve was fitted to the numbers of people in the age-classes, 10-19, 20-69, and 70-89. The oldest and open-ended age-class was assumed to end at age 90. Then, three points were chosen on the curve to determine the values of three constants of the exponential equation.

[20] This applies, of course, only to marriageable age-classes. If we define marriageable ages as 15 and upward following a common practice, this method, it seems to us, tends to exaggerate the number of married women in the age-class 15-19. For the proportions of the married in this age-class in older days computed according to

method is not only expedient but also makes some sense. If n_i^t is the proportion of the non-married (single, divorced, and widowed) in age-class i and w_i^t the proportion of women belonging to age-class i, both in year t, n_i^t may be computed from

$$n_i^t = n_i^{1890} \times \frac{\Sigma\, n_i^t w_i^t}{\Sigma\, n_i^{1890} w_i^t}.$$[21]

Table IV-7 shows the given or estimated proportion of married women by age-class for several American colonies, states, and cities as well as some foreign countries. Marriages were earlier and more general in America than in Europe during the last part of the eighteenth century and the first half of the nineteenth century. The marriage customs of American women in those days were probably comparable to those of Canadian women. Later in the nineteenth century the age at marriage of American women became higher and the incidence of marriage lower. Since the marriage customs in Europe did not change very much during the century, the difference between the American and the European marriage customs became smaller but still remained around the turn of the century.

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this method (more than 20% in many cases) are too large in view of the relatively small proportion reported for age-class 10-19 in Connecticut in 1774 (3.2%). Therefore, it was assumed that all the women under 18 were single. Even then, the estimated number of married women under 20 years of age may be a little too large; the estimated proportion of the married among women aged 15-19 being 14.1% for New Hampshire in 1773, 13.7% for New York in 1825, while the comparable proportion for Connecticut in 1774 could not have been much above 7%.

[21] The age-distributions of women of child-bearing age for New York in 1825 and 1845, and Michigan in 1854 were linearly interpolated or extrapolated from the age-distribution of women in these states reported in the United States Censuses. For example, the age-distribution for New York in 1845 was obtained by averaging the number of women belonging to each age-class in 1840 and 1850. The age-distribution for Michigan in 1854 was computed in a similar way from the Censuses of 1850 and 1860. The age-distribution for New York in 1825 was extrapolated from the age-distributions in 1830 and 1840. The method of estimating the age-distribution of women in colonial Connecticut and New Hampshire is explained in footnote 19 in this chapter. When an age-class was decennial, it was subdivided into two quinquennial age-classes by using the formula $b_1 = \frac{A + 8B - C}{16}$, where B is the number of persons belonging to the decennial age-class to be subdivided, A and C the sizes of decennial age-classes respectively ten years younger and ten years older than B, and b_1 the size of the younger of the two quinquennial age-classes to be created from B. The rationale of this method is explained in Chapter I, pp. 32-33. The number of the married in a quinquennial age-class in 1890 was estimated, where necessary, in the same way from the given numbers of the married in the decennial age-classes.

TABLE IV-7

PROPORTION OF MARRIED WOMEN AMONG ALL WOMEN, BY AGE: AMERICAN CITIES, COLONIES, AND STATES, ENGLAND AND WALES, SWEDEN, AND CANADA, 1773-1900

	YEAR AGE:	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Aggregate for the age-class in brackets
Boston	1845	.062	.339	.598	.694	.688	.648	.604	.469 (15 & up)
	1890	.029	.264	.511	.634	.664[d]		.601[e]	.448 (")
Charleston	1848[a]	.094	.451	.657	.638	.591	.565	.510	.446 (15 & up)
Connecticut	1774[a]	.070[b]	.545[b]	.733[b]	.816[b]	.841[b]	.840[b]	.819[b]	.735 (20-69)
	1890[a]	.043	.326	.605	.729	.766[d]		.712[e]	.615 (")
New Hampshire	1773[a]	.141[b]	.552[b]	.728[b]	.797[b]	.832[b]	.836[b]	.817[b]	.668[h] (16 & up)
	1890	.081	.397	.636	.727	.776[d]		.733[e]	.564[h] (")
New York	1825	.137[b]	.545[b]	.734[b]	.815[b]	.831[b]	.824[b]	.798[b]	.597[h] (16-44)
	1845	.113[b]	.479[b]	.704[b]	.794[b]	.812[b]	.803[b]	.775[b]	.588[h] (")
	1890	.054	.368	.638	.748	.764[d]		.703[e]	.533[h] (")
Michigan	1854	.137[b]	.563[b]	.802[b]	.879[b]	.896[b]	.890	.869	.733[i] (18 & up)
	1890	.090	.496	.772	.860	.878[d]		.829[e]	.697[i] (")
England & Wales	1851	.025	.308	.643[c]		.757[d]		.715[e]	.504 (15 & up)
	1891	.019	.296	.653[c]		.761[d]		.706[e]	.501 (")
Sweden	1800	.027	.194	.507	.675	.747	.767	.739	.501 (15 & up)
	1900	.011	.194	.477	.632	.699	.717	.712	.469 (")
Canada	1851	.108	.656[j]		.871[k]			.810[f]	

Note: *a.* For whites only. *b.* Estimated. *c.* For ages 25-34. *d.* For ages 35-44. *e.* For ages 45-54. *f.* For ages 40-59. *g.* The proportion of the married in the age-class 65-69 was estimated graphically. *h.* All married women were assumed to be 16 years of age or older. *i.* All married women were assumed to be 18 years of age or older. *j.* For ages 20-29. *k.* For ages 30-39.

Source: Boston in 1845, L. Shattuck, *Report to the Committee of the City Council Appointed to Obtain the Census of Boston for the Year 1845*, Boston 1846, p. 61; Michigan in 1855, Michigan Department of State, *Census and Statistics of the State of Michigan; May 1854*, Lansing 1854, p. 378; Charleston, Charleston City Council, *Census of the City of Charleston, South Carolina, for the Year 1848*, Charleston 1849, pp. 26-27; Connecticut in 1774 and New Hampshire in 1773, Monahan, *op. cit.*, p. 21, and U. S. Bureau of the Census, *A Century of Population Growth*, pp. 150, 168; New York in 1825 and 1845, New York (State), Secretary of State, *Census of the State of New York for 1855*, Albany 1857, p. xiii; all states and Boston, 1890, U. S. Bureau of the Census, *Sixteenth Census of the United States; 1940, Population*, Vol. IV, *Characteristics by Age*, Washington 1943; England and Wales, Great Britain Census Office, *Census of England and Wales, 1891*, Vol. IV, *General Report with Summary Tables and Appendices*, London 1893, p. 112; Sweden, Gille, *loc. cit.*, pp. 27, 58; Canada, Table IV-3.

In order to evaluate the effect of different marriage customs and age-distributions, the Swedish marital fertility rate for 1776-1800 was applied to the number of married women for each locality and year. The third column in Table IV-8 shows the

TABLE IV-8

AGGREGATE EFFECT OF MARRIAGE CUSTOMS AND AGE-DISTRIBUTION OF WOMEN ON THE REFINED BIRTH RATE: AMERICAN CITIES, COLONIES, AND STATES, SWEDEN, AND ENGLAND AND WALES, 1773-1900

Marriage Customs and age-distribution in: (1)	YEAR (2)	Refined birth rate standardized for age-specific marital fertility [a] (3)	Number of children under 10 years of age per 1,000 women aged 15-44 (4)	Refined birth rate [f] (5)	Index of marital fertility (5)/(3) (6)
Connecticut	1774	183.9 [e]	1,531 [e]	231.2 [e]	1.26
	1890	152.0 [e]	728 [e]	100.1 [e]	.66
New Hampshire	1773	192.6 [e]	1,611 [be]	242.2 [be]	1.26
	1890	163.5 [e]	673 [e]	92.9 [e]	.57
New York	1825	194.0	1,511 [ce]	232.2 [e]	1.20
	1845	183.2	1,122 [ce]	164.4 [e]	.90
	1890	161.0	768 [e]	107.3 [e]	.67
Michigan	1854	205.3	1,334 [de]	200.3 [e]	.98
	1890	194.0	1,000 [e]	142.2 [e]	.73
Boston	1845	155.4	784 [ce]	111.3 [e]	.72
	1890	134.2	554 [e]	75.3 [e]	.56
Charleston	1848	163.0 [e]	902 [e]	127.2 [e]	.78
Sweden	1800	127.6	985	139.1 (131.2) [g]	1.09 (1.03) [g]
	1900	115.2	1,031	123.0 (109.5) [g]	1.07 (.95) [g]

Note: *a.* Hypothetical refined birth rate of a population with the marriage customs and the age-distribution of women of the place and year at left and specific marital fertility in Sweden for 1776-1800. *b.* 1800. *c.* Average of figures for two census years immediately before and after each date. The ratio of children under 10 to women aged 15-44 in New York in 1820 was computed by dividing the ratio of children under 10 to women aged 16-44 in 1820 by the ratio, in 1830, of the number of women aged 15-44 to the number of women aged 16-44. *d.* Interpolated linearly from the figures for 1850 and 1860. *e.* For whites only. *f.* To estimate the refined birth rate (b) for an American colony, state, or city, first, the rate of increase of yearly births (r) was estimated on an assumption that it is the same as the rate of increase of women aged 15-44. The method of computation may be written as $\sum_{x=15}^{44} w_x = \sum_{x=20}^{49} \frac{l_{x-5}}{l_x} w_x (1+r)^5$, where w_x is the number of women aged x and l_x the

number of life-table survivors at the beginning of the xth year. For 1890 Glover's life table for Massachusetts in 1890 and for all earlier years Jacobson's United States life table for 1850 was used.

Then, the refined birth rate (b) was estimated from $b = \frac{1.03\beta l_0}{\sum_{x=0}^{9} L_x(1+r)^{-x}}$ where β is the number of children under 10 years of age per 1,000 women aged 15-44, L_x the number of persons aged x in a life-table population, l_0 the number of yearly births in the life-table population, and 1.03 a correction factor for allowing for the underenumeration of children under 10 years of age. For 1890, Glover's life table for Massachusetts in 1890, and for all earlier years Jacobson's United States life table for 1850 was used. *g.* Illegitimate births are excluded.

Source: Marriage customs, Table IV-7; number of children per 1,000 women, U. S. Censuses. Cf. Appendix III; U. S. Bureau of the Census, *A Century of Population Growth*, pp. 168-169, and Gille, *loc. cit.*, pp. 19-20; age-distribution, U. S. Censuses. Cf. Appendix III; U. S. Bureau of the Census, *A Century of Population Growth*, pp. 168-169, footnote 19, Chapter IV, and Gille, *loc. cit.*, p. 20; Swedish marital fertility, *ibid.*, p. 31; the number of yearly births in Sweden, Kuczynski, *op. cit.*, pp. 100-101; life table, Paul H. Jacobson, "An Estimate of the Expectation of Life in the United States in 1850," *The Milbank Memorial Fund Quarterly*, April 1957, 35, p. 199, U. S. Bureau of the Census, *United States Life Tables, 1890, 1901, 1910, and 1901-1910,* by James W. Glover, Washington 1921, pp. 132, 138.

refined birth rate standardized for specific marital fertility, or more specifically, the hypothetical refined birth rate of a population with the age-distribution and the marriage customs of women of the place and year mentioned at left and the age-specific marital fertility rate in Sweden in 1776-1800. The relative levels of the standardized birth rates show the effects of marriage customs and age-distributions upon the refined birth rates. The standardized birth rates for Sweden and England and Wales are much smaller than those for the American colonies and states. Within the United States, the change in marriage customs and in age-distribution, over time, tended to pull down the birth rate considerably but even as late as the end of the nineteenth century the standardized birth rate in an American state was still considerably higher than in Europe.

The estimates of the actual refined birth rates in American cities, colonies, and states (Column 5) were made from their numbers of children under 10 years of age per 1,000 women aged 15-44, using for 1890 Glover's Massachusetts Life Table for 1890 and for all earlier dates Jacobson's life table for Massachusetts and Maryland in 1850.[22] Then, Column 5 was divided

[22] See note to Table IV-8 for the method of estimation.

by Column 3.[23] What is left in Column 6 — the variations in marriage customs and age-distribution having been removed — is mostly the variation in marital fertility, and, to some extent, the variation in the proportion of illegitimate to legitimate births and the variation in the geometric property of the specific marital fertility curve. In the United States during the first half of the nineteenth century, illegitimacy may have been negligible and the shape of the specific marital fertility curve is not expected to have been widely different from the shape of the Swedish curve. Hence, we may take the ratios in Column 6 as approximately showing the ratios of the American marital fertility to that in Sweden for 1776-1800.

Thus, marital fertility was only slightly higher in colonial Connecticut and New Hampshire than in Sweden, even though the refined birth rate was much higher in the former than in the latter. Apparently as contemporary observers said, the refined birth rate in American colonies was higher than in Europe, primarily because "marriages in America" were "more general, and more generally early than in Europe." [24]

The index of marital fertility, if we are allowed to call Colum 6 so, declined steadily in the United States during the nineteenth century, unlike in Australia or in Canada. As early as in the middle of the century, the index was much lower in American states than in previous times. Since the effect of the change in the relative amount of illegitimacy among whites is expected to have been small at any rate before 1850, this means largely a reduction in intramarital fertility. After the middle of the nineteenth century, the indices for American states and cities decreased further, and that in the face of a probable small increase in the relative amount of illegitimacy [25] which tended to

[23] The standardized refined birth rates for New York, Michigan, and Boston are for the white and the colored, while the estimated refined birth rates for these localities are for whites only. However, the proportion of the colored population in these localities were so small as to be neglected; the proportion having been 1.6% for New York, and .7% for Michigan in 1850, 1.6% for Boston in 1845, and 1.2% for New York, .7% for Michigan and 1.8% for Boston in 1890.

[24] Benjamin Franklin, "Observations Concerning the Increase of Mankind and the Peopling of Countries," in *The Works of Benjamin Franklin*, ed. by Jared Sparks, Vol. II, Boston 1836, pp. 312-313. Cf. A. Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations,* Modern Library edition, ed. by E. Cannan, New York 1937, p. 70.

[25] Reliable statistics of illegitimate births are unavailable for the United States but in view of the increase in the proportion of single persons at young ages and

increase the index. In contrast, there was practically no change in the index in Sweden between 1800 and 1900, although a part of the fall in marital fertility was masked by a rise in the illegitimacy ratio.[26]

In the United States most of the differences in the refined birth rate between localities of comparable rurality at a comparable time before the Civil War such as Connecticut and New Hampshire toward the end of the eighteenth century, Michigan and New York in the middle of the nineteenth century, and Charleston and Boston also in the middle of the nineteenth century, can be explained by differences in marriage customs and age-distribution. However, the difference in the refined birth rate between urban communities (Charleston and Boston) and states (Michigan and New York) can be accounted for only partially by differences in marriage customs and age-distribution. Though part of the remaining variation in the refined birth rate may be explained by the differential in child mortality which was not taken into account, it is likely that the specific martial fertility was lower in cities than in rural areas.

So far, we have found that the aggregate effect of the changes, over time, in marriage customs and age-distribution was to lower the refined birth rate. But we do not yet know whether both of these variables worked in the same direction, or, if they did, what the contribution of each was toward the decrease of the refined birth rate. In order to answer these questions, the effect of a change in each variable was separately measured, the other variable along with specific marital fertility being kept constant over time. Table IV-9 shows that the change in the age-distribution of women of child-bearing age tended to raise, though slightly, the refined birth rate. Changes in marriage customs,

the decline in the importance of religious inhibitions, it may be presumed that illegitimacy increased over time.

[26] The ratio of illegitimate to total births in Sweden which was about 5% around 1800 increased to 11% in 1900. (Figures were computed from Frederick Hendricks, "On the Vital Statistics of Sweden, from 1749 to 1855," *Journal of the Statistical Society of London*, June 1862, 25, pp. 163-164; Arthur Newsholme and T. H. C. Stevenson, "The Decline of Human Fertility in the United Kingdom and Other Countries as Shown by Corrected Birth-Rates," *Journal of the Royal Statistical Society*, March 1906, 69, pp. 82-83; R. R. Kuczynski, *The Balance of Births and Deaths*, Vol. 1, *Western and Northern Europe*, New York 1928, p. 7. If illegitimate births are excluded from total births, the refined birth rates become 131.2 and 109.5 respectively for 1800 and 1900 and the indices of marital fertility 1.03 and .95.

TABLE IV-9

EFFECT OF MARRIAGE CUSTOMS AND AGE-DISTRIBUTION OF WOMEN ON THE REFINED BIRTH RATE AND THE CONTRIBUTION OF THE CHANGE IN MARRIAGE CUSTOMS TOWARDS THE DECREASE IN THE REFINED BIRTH RATE: CONNECTICUT, NEW HAMPSHIRE, NEW YORK, MICHIGAN, AND BOSTON, 1773-1890

		Refined birth rate standardized with respect to the marriage customs of women & specific marital fertility [a] (1)	Refined birth rate standardized with respect to the age-distribution of women & specific marital fertility [b] (2)	Rate of decrease in (2) (3)	Refined birth rate standardized indirectly to the age-distribution of women of the earliest year for each place (4)	Rate of decrease in (4) (5)	Contribution of the change in marriage customs toward the decrease in the refined birth rate (3) ÷ (5) (6)
Connecticut	1774	183.9	183.9		231.2		
	1890	193.3	145.3	21.0%	95.2	58.8%	35.7%
New Hampshire	1773	192.6	192.6		242.2		
	1890	197.1	160.5	16.7	90.8	62.5	26.7
New York	1825	194.0	194.0		232.2		
	1845	196.8	180.0	7.2	162.3	30.1	23.9
	1890	200.3	152.2	21.5 [c]	105.3	54.7 [c]	39.3 [c]
Michigan	1854	205.3	205.3		200.3		
	1890	209.5	191.2	6.9	139.3	30.4	22.7
Boston	1845	155.4	155.4		111.3		
	1890	154.8	133.4	14.1	75.6	32.1	43.9

Note: *a.* Hypothetical refined birth rate of a population with age distribution of women of the place and year at left, marriage customs of women of the earliest year for each place and specific marital fertility in Sweden 1776-1800. *b.* Hypothetical refined birth rate of a population with the marriage customs of women of the place and year at left, the age-distribution of women of the earliest year for each place and specific marital fertility in Sweden for 1776-1800. *c.* Decrease between 1825 and 1890.

Source: Marriage customs, Table IV-7; refined birth rate, Table IV-8; age-distribution, U. S. Censuses, cf. Appendix III; Swedish marital fertility, Gille, *loc. cit.*, p. 31.

therefore, played a still greater part in reducing fertility than the figures in Table IV-8 show.

The refined birth rate was also standardized with respect to the age-distribution of women (Column 4 in Table IV-9). The change in marriage customs, as seen in Column 6 in the Table,

accounted for a considerable but not a major part of the decline in the refined birth rate. Thirty-six per cent of the decline in the refined birth rate in Connecticut between 1774 and 1890 is explained by the change in marriage customs. The contribution of the change in marriage customs in reducing fertility in New Hampshire between 1773 and 1890 was 26.7%.[27] The contribution was still larger in New York between 1825 and 1890 where it was 39.3%. The contribution in New York between 1825 and 1845—23.9%—was smaller than that for the entire period of 1825-1890, but the actual effect is likely to have been greater than nidicated by the figure, since the estimated refined birth rate in 1845, which was partly based on the ratio of children to women in 1850, was probably too low due to the unusually large degree of underenumeration of young children in 1850. In Boston the contribution of the change in marriage customs—43.9% between 1845 and 1890—was comparable with, or greater than, those for other states already mentioned. However, the change in marriage customs accounted for only 22.7% of the decline in fertility in Michigan between 1854 and 1890.

All these localities had relatively low refined birth rates to begin with. In view of the frequent references to the prevalence of marriages of females at ages below 20 in contemporary literature,[28] marriages in other parts of the United States in older days may have been earlier and more general than marriages in the localities for which we have data. But, then, marriages were earlier and more general in these higher-birth-rate states than in the lower-birth-rate states in 1890. Therefore, the effect of the change in marriage customs on the reduction of the refined birth rate may not have been any larger in the former. Thus, we must conclude that, although the change in marriage customs accounted for a considerable portion of the fall in the refined birth rate, it probably did not play as important a role in reducing the birth rate as it did in Canada or in Australia. It is possible that this factor may have been important in states for which we have no data but we can only conjecture about this.

[27] The fall in the refined birth rate in New Hampshire shown is from 1800 to 1890. Therefore, 27.5% should be viewed as the maximum amount of contribution of the change in marriage customs toward the reduction in the refined birth rate.

[28] Calhoun, *op. cit.*, Vol. II, pp. 13-15; Monahan, *op. cit.*, p. 99.

3. *Cross Section Analysis of New York Data*

The New York State Censuses of 1825, 1835, and 1845 recorded the number of married women under 45 years of age and the number of non-married women aged 16-44 by county.[29] On an assumption that all married women were 16 years of age or older, the proportion of the married among women aged 16-44 in a county was computed from the data for 1825 and 1845. Also recorded in these censuses are the numbers of births which occured in different counties during one year preceding a census date. From these numbers the refined birth rate, defined in this section as the number of births per 1,000 women *aged 16-44*, was computed for each county in 1825 and 1845.

As is seen in Appendix I there was a wide variation in the proportion of the married among women aged 16-44 and also in the refined birth rate from county to county. There is a clear-cut association between these two variables. Spearman's coefficient of rank correlation,[30] r_r, between the proportion of the married among women aged 16-44 and the refined birth rate in a county [31] was as high as .885 in 1825 and .803 in 1845. Both are significant at the 1% level. The larger the proportion of married women, the higher the birth rate in a county tended to be.

If (1) the age-distribution of women within child-bearing age, (2) the ratio of the specific proportion of the married for a certain age to that for another age, (3) the specific marital fertility rate, and (4) the relative amount of underenumeration of births in relation to undernumeration of women of child-bearing age were the same in every county, the marital birth rate [32]

[29] Later censuses of the State gave up this practice and simply divided the total population by marital status.

[30] In this section, but only in this section, Spearman's rather than Kendall's coefficient of rank correlation was used, because the number of observations (55) was too large for Kendall's coefficient to be computed easily, and sufficiently large to permit the test of significance for Spearman's coefficient.

[31] To maintain comparability, the counties of Wyoming, Chemung, and Fulton which existed in 1845 but not in 1825 and the county of Hamilton which existed in 1825 but was left out somehow in the census tabulation were treated as a part of the county from which they respectively originated. The total number of counties is 55.

[32] The marital birth rate is the number of yearly births per 1,000 married women of child-bearing age, in this section, taken to be ages 16-44.

would be the same everywhere; or, if we allow for random variations in each of the four variables, variability in the marital birth rate should be confined within a small range explainable by randomness in each variable and there should not be any association between the proportion of the married and the marital birth rate. This was apparently not the case. Although the coefficient of variation of the marital birth rate was much smaller than that of the refined birth rate (the former was 10.3% in 1825 and 6.2% in 1845 while the latter was 21.2% and 12.2% respectively), the remaining variability seems to be too great to be explained by random variations in the three variables. Moreover, there is a positive association between the proportion of the married and the marital birth rate, Spearman's coefficient of rank correlation being .624 and .407 respectively for 1825 and 1845. Both coefficients are significant at the 1% level.

Several explanations may be offered for this. First, a difference in another variable, say the extent of urbanization, may be the cause both of the difference in the proportion of married women and the difference in marital birth rate. If urbanization gave rise to a motive to restrict the number of children, some people may have postponed marriage and others may have resorted to contraceptive techniques of some sort to achieve the same objective.[38]

Secondly, it is most likely that when the overall proportion of the married among women aged 16-44 was larger, the average age at marriage was younger. If so, a population with a higher proportion of the married had an age-distribution of *the married* more heavily weighted with the young than a population with a lower proportion of the married did. Since specific marital fertility was higher at younger ages, the former would, *caeteris paribus*, have a higher overall marital birth rate.

Thirdly, the degree of urbanization was likely to be associated with the age-distribution of population and hence, *caeteris paribus,* the age-distribution of married women. Urban communities are expected to have had age-distributions weighted with older people not only because the birth rate was lower but also because

[38] Spearman's coefficient of rank correlation between population density and the refined birth rate in a county is –.707 in 1825 and –.436 in 1845. Both coefficients are significant at the 1% level. Population density is defined here as the number of persons per square mile of all kinds of land. See Appendix I.

of the nature of migration between urban and rural areas. Therefore, urban areas may have tended to have both lower proportions of the married and lower marital birth rates.

Fourthly, it may seem that the relative amount of underenumeration of births in relation to underenumeration of women of child-bearing age may have been systematically different in different counties causing the apparent differentials in the marital birth rates. However, the relative amount of underenumeration of births is likely to have been larger in rural than in urban counties and, if so, the variation in the relative amount of underenumeration tended to mask the variation in the true marital fertility rate rather than explain the variation in the reported rate.

To assess quantitatively the change in the effect of different marriage customs and age-distributions on the birth rate, the age-specific proportion of married women was estimated for 1825 and 1845 in the same way as in the preceding section, namely, assuming that the shape of the curve of the specific proportion of the non-married was geometrically similar to that for New York State in 1890. Partly for the purpose of simplifying computation and partly for the purpose of reducing random variations, counties were classified into five groups of eleven each, in the order of their refined birth rates. The age-distribution of women within child-bearing age, which was not given in the state censuses, was estimated from the United States censuses of 1830 and 1850. The age distribution of women aged 15-44 in 1825 was taken from the age-distribution of women aged 20-49 in 1830. The age distribution of women aged 15-44 in 1845 was estimated in a similar way, using the United States census in 1850.[34] As in the previous section, the Swedish specific marital fertility rate was applied to the number of married women in each age-class[35] and the standardized refined birth rate was computed.

The result of the computation is shown in Table IV-10. The second column of the Table shows the refined birth rate of each county group standardized for the marital fertility rate. The fourth column which was derived by dividing the third column,

[34] The relative size of a sub-class within a decennial age-class in each county group was assumed to be the same as that for the State of New York in each year.

[35] The age-class 45-49 was ignored.

TABLE IV-10

AGGREGATE EFFECT OF MARRIAGE CUSTOMS AND AGE DISTRIBUTION ON THE REFINED BIRTH RATE,[a] BY COUNTY GROUP:[b] NEW YORK, 1825 AND 1845

	1825			1845		
County group (1)	Refined birth rate[a] standardized for specific marital fertility[c] (2)	Refined birth rate[a] as reported by census (3)	Ratio (3)/(2) (4)	Refined birth rate[a] standardized for specific marital fertility[c] (5)	Refined birth rate[a] as reported by census (6)	Ratio (6)/(5) (7)
I	253.1	255.7	1.010	216.8	186.6	.861
II	227.9	218.4	.958	206.8	165.7	.801
III	211.5	198.8	.940	206.2	153.6	.745
IV	190.3	177.8	.934	186.9	143.3	.767
V	178.5	130.7	.732	178.3	129.6	.727

Note: *a*. Refined birth rate is defined in this section as the number of yearly births per 1,000 women aged 16-44. *b*. Counties are grouped according to their refined birth rates. I includes counties with the highest birth rates and V counties with the lowest birth rates. Counties included in each group are as follows: In 1825; I, Orleans, Cattaraugus, Allegany, Chautauque, Erie, Steuben, Sullivan, Niagara, Warren, Broome, and Yates; II, Jefferson, St. Lawrence, Franklin, Wayne, Essex, Schoharie, Seneca, Monroe, Genesee, Delaware, and Tompkins; III, Tioga, Lewis, Onondaga, Oswego, Cortland, Ulster, Chenango, Livingston, Cayuga, Herkimer, and Clinton; IV, Schenectady, Ontario, Putnam, Greene, Otsego, Montgomery, Madison, Albany, Oneida, Rensselaer, and Orange; V, Rockland, Saratoga, Washington, Richmond, Dutchess, Columbia, Queens, Suffolk, Westchester, Kings, and New York. In 1845; I, Clinton, Sullivan, Franklin, Steuben, St. Lawrence, Essex, Warren, Ulster, Cattaraugus, Tioga, and Oswego; II, Niagara, Schoharie, Erie, Allegany, Rockland, Jefferson, Seneca, Putnam, Greene, Lewis, and Broome; III, Yates, Wayne, Rensselaer, Monroe, Montgomery, Suffolk, Kings, Onondaga, Albany, Orleans, and Chautauque; IV, Orange, Oneida, Livingston, Schenectady, Westchester, Herkimer, Queens, Cayuga, Chenango, Cortland, and Columbia; V, Madison, Ontario, Dutchess, Genesee, Tompkins, Saratoga, Otsego, Washington, New York, Richmond, and Delaware. *c*. Hypothetical refined birth rate of population with marriage customs and age-distribution of women of county group at left and specific marital fertility in Sweden for 1776-1800.

refined birth rate as reported by censuses, by the second column shows the relative level of marital fertility in a county group in relation to Swedish fertility, provided that all the births were counted in New York counties. As they were not, the absolute value of the ratio may not be meaningful but the relative levels of the ratios in different county groups may be taken to represent the relative levels of marital fertility.

Most of the large differences in the refined birth rate among the first four county groups in 1825 can be explained by the differences in marriage customs, though there was a tendency for the marital fertility to be slightly higher in counties with higher refined birth rate. Group V, which included New York County and other more urbanized counties, was an exception. Intramarital fertility in this county group was much lower than in other groups.

By 1845, Group V ceased to be exceptional as a result of the fall in the ratio of the actual to the standardized birth rate in other groups. The variation in the specific proportion of the married can still explain a large part of the variation in the refined birth rate but now the specific marital fertility increases more or less gradually from one county group to another, including Group V.

4. *Sex Ratio and Fertility*

In an article[36] in a recent issue of the *Milbank Memorial Fund Quarterly* H. Yuan T'ien analyzed the relationship between sex ratio and fertility in a state or territory. He doubted that in a country at the incipient stage of industrialization-urbanization such as the United States during the first half of the nineteenth century socio-economic forces could play an important role in affecting fertility. As an alternative T'ien suggested a hypothesis that the sex ratio affected the marriage customs and, through the latter, fertility. He figured that " a great majority of females in the areas of high sex ratios were likely to be married and contribute substantially to reproduction as measured by the fertility ratio." [37] On the contrary, " In an area where the number of females exceeded the number of males, not all of the females could be married in a monogamous society. The ratio for such places would therefore be lower because a larger proportion of unmarried females were included." [38]

[36] H. Yuan T'ien, "A Demographic Aspect of Interstate Variations in American Fertility, 1800-1860," *The Milbank Memorial Fund Quarterly,* January 1959, 37.

[37] T'ien defined the fertility ratio as the ratio of children under 5 years of age to women aged 16-44 or 15-49. The method he used for estimating the number of children under 5 years of age in 1800, 1810, and 1820 is the same as the one used by Willcox, and Thompson and Whelpton. Cf. Chapter I, p. 25.

[38] *Ibid.*, p. 51.

To test the hypothesis, T'ien computed the sex ratio for whites aged 16-44 between 1800 and 1820 and aged 15-49 between 1830 and 1860. (See Table IV-11.) Kendall's coefficients of rank correlation between the sex ratio and the fertility ratio in a state or territory turned out to be .66, .57, .38, .58, .48, .49, and. 49 respectively for successive census years between 1800 and 1860. All the coefficients were significant at the 1% level of probability.[39]

Thus, " the notion that demographic factors (of which the sex ratio is one) could have accounted, to some extent, for interstate fertility differences in the early years of the 19th century " was supported by statistical evidence. Whereupon, T'ien concluded, that " the reported early decline in American fertility probably could have differed intrinsically from the later fall in the birth rate resulting from voluntary and deliberate family limitation." [40]

Two questions may be asked about his analysis. First, was the interstate variation in the sex ratio large enough to *cause* the wide differential in fertility? Except in a few newly settled areas, the sex ratios were within a small range, say within 10% of the median ratio. Since competition for a spouse could have affected the age at marriage considerably, this does not necessarily negate the hypothesis that the variation in the sex ratio *caused* the wide variation in fertility. However, it may lead us to suspect that both the variation in fertility and the variation in the sex ratio may have been *caused* by another variable.

The second question is whether the sex ratio can explain the trend in fertility. The answer is definitely no. Although the sex ratio tended to decrease in newer areas, the fall was not consistent even in these areas. Moreover, in most older states, there was absolutely no tendency for the sex ratio to fall. Yet, fertility decreased greatly in every one of these states.

In conclusion we might say that, although it is reasonable to assume that the sex ratio affected fertility through marriage customs, it is doubtful that it was an important factor in causing interstate differentials in fertility and in reducing fertility over time. Significant positive correlations between the sex ratio and fertility are likely to have been chiefly the result of correla-

[39] *Ibid.*, p. 56.
[40] *Ibid.*, pp. 56-57.

tions between these two variables, on one hand, and one or more other variables, say interstate migration, the degree of urbanization, or the availability of land, on the other.

TABLE IV-11

SEX RATIO, OR THE NUMBER OF WHITE MALES PER 1,000 WHITE FEMALES BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	1,015	994	953	991	1,005	1,051	1,005
New Hampshire	956	920	902	905	930	954	938
Vermont	1,068	956	954	970	993	1,047	1,009
Massachusetts	925	951	1,004	942	994	961	922
Rhode Island	872	925	1,123	923	927	965	919
Connecticut	920	926	1,096	962	957	998	968
Middle Atlantic							
New York	1,060	1,057	1,034	1,040	1,030	1,026	964
New Jersey	992	1,002	975	1,031	1,001	930	983
Pennsylvania	1,054	1,011	1,020	1,034	1,005	1,025	988
South Atlantic							
Delaware	963	995	1,001	989	960	1,009	1,038
Maryland	1,010	1,025	1,013	1,024	980	1,042	979
Virginia	1,004	981	986	970	972	1,002	1,001
North Carolina	986	961	944	936	917	932	953
South Carolina	1,049	1,047	1,034	992	990	986	984
Georgia	1,112	1,103	1,099	1,077	1,066	1,032	1,025
Florida				1,420	1,773	1,281	1,153
East North Central							
Ohio	1,315	1,089	1,091	1,066	1,072	1,065	1,029
Indiana	1,360	1,120	1,111	1,065	1,077	1,081	1,086
Illinois		1,342	1,330	1,155	1,269	1,152	1,168
Michigan		1,982	2,327	1,623	1,220	1,146	1,149
Wisconsin					2,053	1,247	1,137
East South Central							
Kentucky	1,097	1,070	1,027	1,061	1,103	1,084	1,077
Tennessee	1,070	1,052	984	1,018	988	992	1,039
Alabama			1,258	1,178	1,162	1,063	1,046
Mississippi	1,643	1,485	1,402	1,306	1,316	1,170	1,138
West North Central							
Minnesota						2,028	1,274
Iowa					1,519	1,139	1,140
Missouri		1,299	1,409	1,675	1,236	1,182	1,180
Dakota							1,710
Nebraska							1,667
Kansas							1,377

State or territory	1800	1810	1820	1830	1840	1850	1860
West South Central							
Arkansas			1,363	1,402	1,368	1,182	1,154
Louisiana		1,372	1,611	1,479	1,557	1,385	1,192
Texas						1,350	1,301
Mountain							
Colorado							29,263
New Mexico						1,032	1,161
Utah						1,249	974
Nevada							1,429
Pacific							
Washington							4,624
Oregon						2,319	2,027
California						20,019	3,277

Note: The sex ratio is computed for persons aged 16-44 between 1800 and 1820 and 15-49 between 1830 and 1860. Therefore, ratios are comparable between 1800 and 1820 and between 1830 and 1860, but not comparable between 1820 and 1830.

Source: T'ien, *loc. cit.*, pp. 58-59.

5. *Effect of the Age-Distribution of Women of Child-Bearing Age*

As seen in Appendix II, the age-distribution of women within child-bearing age was different from one state to another in the same census year and from one census year to another within the same state. A higher mortality within child-bearing ages would cause a steeper decline in the number of women of a certain age as age increases. Likewise a sustained higher fertility would lead to a faster increase of yearly births and, hence, to an age-distribution weighted with younger women. Most New England states with low fertility, had relatively more old women and southern and western states, with high fertility, tended to have a relatively youthful population. In the states in the lower Mississippi Valley where high mortality was coupled with high fertility, the population was particularly youthful..

Another cause of the differences in age-distribution is the selectiveness of migration with respect to ages. Since there were relatively more migrants in their twenties and thirties, a state with a large volume of recent immigration tended to have a relatively

large number of persons in these age-classes. California, Kansas, and Minnesota in 1860 are good examples of this kind. Conversely we may expect that a state experiencing emigration should have an age-distribution with a high proportion of the very young and very old. This was the case in most states in the South Atlantic Division.

The effect, on the refined birth ratio, of the differences in age-distribution due to differences in fertility and / or mortality was to increase the ratios of states with older population and to decrease the ratios of more youthful states. For, since the refined birth ratio measures the fertility experiences of women in the past ten years, the birth-ratio for women at young ages tended to be very low and the birth-ratio at ages which were older than ages of peak current fertility tended to be relatively high.

A disturbance in the age - distribution caused by migration affected the refined birth ratios of net-immigrant states favorably and those of net-emigrant states unfavorably. For the shape of the age-specific refined birth ratio was bell-shaped; lower at young ages because of the small proportion of the married and lower at old ages because of lower intramarital fertility.

In order to remove the effect of different age-distributions, we have to know not only the age-distribution of women within child-bearing age, but also the shape of the curve of the age-specific fertility rate. For our period of 1800-1860, there are no statistics of the age-specific fertility rate. All we can do is to use either a contemporary foreign fertility rate or an American fertility rate of a later year.

We chose to use the age-specfic ratio of " own " children [41] under 5 to native white women in the United States in 1910. Since the average age at marriage was undoubtedly higher in 1910 than before the Civil War, the lower tail of the curve of the specific fertility rate must have been lower in 1910 than in previous times. However, the upper tail of the curve was also likely to be lower in 1910 because specific marital fertility tended to fall more rapidly at older ages.[42] Thus, it may be

[41] " Own " children are: " those children presumably born to the woman and living with her at the time of the census." U. S. Bureau of the Census, *Sixteenth Census of the United States, 1940, Population: Differential Fertility 1940 and 1910*, Vol. 5, *Women by Number of Children under 5 Years Old*, Washington 1945, p. 1.

[42] Wilson H. Grabill, Clyde V. Kiser, and Pascal K. Whelpton, *op. cit.*, pp. 42-45.

presumed that the *shape* of the fertility curve remained relatively unchanged. Moreover, this fertility table is more convenient than others in that it is expressed as the number of children under 5 years of age per 1,000 women in a certain age-class and it can be applied with little manipulation to our data.

The number of children under 10 years of age per 1,000 women of an age-class was computed simply by adding the number of children under 5 per 1,000 women for relevant age-class and that for the age-class 5 years younger.[43] This method ignores the deaths during 1905 - 1909 which occurred to children born between 1900-1904. But since (1) the death rate for the age-class was relatively low and (2) we are concerned only with the shape of the age-specific fertility curve, the effect of the omission should not be important.

All the refined birth ratios between 1830 and 1860 were standardized indirectly to the age-distribution of women in the United States in 1860. The method of standardization was the same as the one described in Section 1 of Chapter I.[44] The ratios for 1800-1820 when population was classified into very broad age-classes were left as they were.

The effect of the age-distribution was minor in most instances. (Tables IV-12 and IV-13) With a few exceptions the rank of a state remained the same or was changed by only one or two places, when the ratio was standardized. Generally speaking the relative levels of the unstandardized ratio of children to women in states in the northern Atlantic area and new states and territories tended to overestimate their relative levels of true fertility and those for net-emigrant states in the South and the Midwest tended to underestimate the true fertility. However, since the unstandardized ratios of northern Atlantic states were among the lowest in the country to begin with, their ranks with respect to the refined birth ratio changed little when the ratios

[43] The fertility table used was as follows:

Age of women	15–19	20–29	30–39	40–49
Fertility ratio	.052	.825	1.263	.591

Source: U. S. Bureau of the Census, *Sixteenth Census of the United States, 1940, Population: Differential Fertility, 1940 and 1910*, Vol. 5, *Women by Number of Children under 5 Years Old*, p. 12.

The ratios for age-classes 20-29, 30-39, and 40-49 are, respectively, the arithmetic means of the ratios for age-classes 20-24 and 25-29, 30-34 and 35-39, and 40-44 and 45-49.

[44] Cf. pp. 30-31 in Chapter I. See also footnote *a.* to Table IV-12.

TABLE IV-12

STANDARDIZED[a] WHITE REFINED BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITE WOMEN AGED 16-44, BY STATE OR TERRITORY: UNITED STATES, 1830-1860

State or territory	Standardized refined birth ratio 1830	1840	1850	1860	Correction factor[a] 1830	1840	1850	1860
New England								
Maine	1,493	1,442	1,253	1,132	.980*	.982*	.971	.979
New Hampshire	1,212	1,111	934	895	.996*	1.001*	.980	1.006*
Vermont	1,357	1,287	1,139	1,082	.983*	.999*	.993*	.997
Massachusetts	1,065	971	839	853	.999*	1.017*	1.022*	1.049*
Rhode Island	1,156	979	884	855	.985*	1.010*	1.029*	1.038*
Connecticut	1,117	1,032	901	898	.997*	1.008*	1.016*	1.036*
Middle Atlantic								
New York	1,496	1,287	1,062	1,028	.980*	.989*	1.008*	1.034*
New Jersey	1,491	1,379	1,210	1,122	.984*	.986*	.998*	1.025*
Pennsylvania	1,608	1,493	1,331	1,296	.955	.975	.993*	.998
South Atlantic								
Delaware	1,436	1,344	1,314	1,284	.970*	.991*	1.000*	.988
Maryland	1,349	1,294	1,225	1,203	.965	.992*	1.010*	1.003*
Virginia	1,651[c]	1,593[c]	1,466	1,435	.961	.969	.969	.981
North Carolina	1,715	1,651	1,427	1,373	.959	.973	.980	.984
South Carolina	1,757	1,698	1,392	1,355	.957	.963	.995	.977
Georgia	2,065	2,063	1,767	1,574	.950	.953	.946	.958
Florida	1,960	1,745	1,770	1,644	.969*	.977	.975	.954
East North Central								
Ohio	1,980[c]	1,767	1,510	1,389	.945	.960	.971	.979
Indiana	2,237	1,915	1,778	1,585	.956	.958	.957	.966
Illinois	2,275	1,931	1,645	1,471	.956	.968	.977	1.000
Michigan	1,860[b]	1,591	1,375	1,311	.986*	1.007*	.992*	.992
Wisconsin		1,517[b]	1,440	1,546		1.034*	1.037*	1.031*
East South Central								
Kentucky	2,025	1,987	1,662	1,564	.934	.951	.961	.970
Tennessee	2,186	2,019	1,685	1,543	.930	.949	.946	.961
Alabama	2,305	2,191	1,707	1,612	.954	.947	.959	.952
Mississippi	2,227	2,103	1,858	1,665	.949	.976	.956	.950
West North Central								
Minnesota			1,477[b]	1,495			1.021*	1.083*
Iowa		1,874[b]	1,749	1,641		.980*	.987	.997
Missouri	2,308[b]	2,040	1,627	1,554	.963	.961	.972	.986
Dakota				1,414				1.039*
Nebraska				1,405				1.039*
Kansas				1,378				1.086*
West South Central								
Arkansas	2,273	2,259	1,973	1,806	.970*	.956	.934	.956
Louisiana	1,807	1,633	1,261	1,294	.962	.978*	1.026*	1.020*
Texas			1,808	1,808			.965	.974

State or territory	Standardized refined birth ratio 1830	1840	1850	1860	Correction factor[a] 1830	1840	1850	1860
Mountain								
Colorado				690				1.108*
New Mexico			1,318[b]	1,381			.960	1.018*
Utah			1,588[b]	1,932			.953	1.037*
Nevada				1,148				1.106*
Pacific								
Washington				1,788				1.033*
Oregon			2,025[b]	2,127			.990*	.989
California			1,096	1,142			1.014*	1.127*
U. S.	1,638	1,550	1,353	1,308	.968	.977	.987	1.000

Note: *a*. Birth ratios are standardized indirectly to the age-distribution of women in the United States in 1860. A standardized birth ratio is obtained by dividing an unstandardized birth ratio by the correction factor (c), which is computed from $c = \frac{\sum w_t r_{1910}}{\sum w_t} \div \frac{\sum w_{1860} r_{1910}}{\sum w_{1860}}$, where w_t is the number of women belonging to an age-class in year t and r_{1910} the age-specific birth ratio computed from the 1910 census. *b*. These figures are not comparable with the later figures because of territorial changes. *c*. Strictly speaking, these figures are not comparable with later figures for the same reason. But the territorial changes involved are rather minor in these cases and are disregarded in the analysis in the text. * Larger than the United States figure.

Source: Table II-7; note 43 in p. 130; and U. S. Censuses. Cf. Appendix III.

TABLE IV-13

RANKS OF STATES AND TERRITORIES WITH RESPECT TO THE WHITE REFINED BIRTH RATIO, OR THE NUMBER OF WHITE CHILDREN UNDER 10 YEARS OF AGE PER 1,000 WHITE WOMEN, AGED 16-44, STANDARDIZED[a] AND UNSTANDARDIZED: UNITED STATES, 1830-1860

State or territory	1830 Unst.	1830 St.	1840 Unst.	1840 St.	1850 Unst.	1850 St.	1860 Unst.	1860 St.
New England								
Maine	19	19	20	20	27	26	34	32
New Hampshire	24	24	26	26	32.5	32	38	38
Vermont	22	22	23	24	29	29	35	35
Massachusetts	27	27	29	29	35	35	39	40
Rhode Island	25	25	28	28	34	34	40	39
Connecticut	26	26	27	27	32.5	33	37	37
Middle Atlantic								
New York	18	18	25	25	30	31	36	36
New Jersey	20	20	21	21	28	28	33	33
Pennsylvania	17	17	19	19	22	22	27	26

State or territory	1830 Unst.	1830 St.	1840 Unst.	1840 St.	1850 Unst.	1850 St.	1860 Unst.	1860 St.
South Atlantic								
Delaware	21	21	22	22	23	24	30	28
Maryland	23	23	24	23	26	27	31	29
Virginia	16[c]	16[c]	18[c]	16[c]	19	17	20	18
North Carolina	15	15	14	14	20	19	23	23
South Carolina	14	14	13	13	21	20	24	24
Georgia	8	8	4	4	8	7	15	11
Florida	10	11	11	12	3.5	6	10	7
East North Central								
Ohio	11[c]	10[c]	12	11	17	15	22	20
Indiana	5	5	10	9	7	5	13	10
Illinois	4	3	8	8	10	12	18	17
Michigan	12[b]	12[b]	15	17	18	21	26	25
Wisconsin			17[b]	18[b]	16	18	8	14
East South Central								
Kentucky	9	9	7	7	11	11	14	12
Tennessee	7	7	6	6	12	10	17	15
Alabama	3	2	2	2	9	9	11	9
Mississippi	6[b]	6[b]	3	3	3	3	9	6
West North Central								
Minnesota					15[b]	16[b]	7	16
Iowa			9[b]	10[b]	5.5	8	6	8
Missouri	1	1	5	5	13	13	12	13
Dakota							32	34
Nebraska							19	19
Kansas							16	22
West South Central								
Arkansas	2	4	1	1	2	2	5	4
Louisiana	13	13	16	15	24	25	25	27
Texas					4	4	4	3
Mountain								
Colorado							41	41
New Mexico					25[b]	23[b]	21	21
Utah					14[b]	14[b]	2	2
Nevada							29	30
Pacific								
Washington							3	5
Oregon					1[b]	1[b]	1	1
California					31	30	28	31

Note: *a.* Birth ratios are standardized indirectly to the age-distribution of women in the United States in 1860. *b.* These figures are not comparable with later figures because of territorial changes. *c.* Strictly speaking, these figures are not comparable with later figures for the same reason. But the territorial changes involved are rather minor in these cases and are disregarded in the analysis in the text.

Source: Tables II-7 and IV-12.

were standardized. Noticeable changes in rank occurred mostly in frontier states and territories, on one hand, where ranks became lower when the ratios were standardized, and in net-emigrant states in the South and the Midwest, on the other hand, where ranks became higher when the ratios were standardized. Notable examples of the former are Michigan and Iowa in 1840 and 1850 and Wisconsin, Minnesota, Kansas, and California in 1860. Virginia, Ohio, and Tennessee in 1850 and Georgia, Florida, and Kentucky in 1860 are examples of the latter.

Since the low ratios for the North Atlantic states became still lower when standardized, and the high ratios for the Southern states and some older Midwestern states became relatively higher when standardized, the variations in the standardized refined birth ratios are larger than the variations in the non-standardized refined birth ratios. The weighted mean deviations of the white refined birth ratio of a state or territory from the United States ratio, weighted by the number of white women age 16-44, for successive census years between 1830 and 1860 are 253, 270, 242, and 209 respectively, when standardized, as against 237, 251, 217, and 184 respectively when not standardized. The trend in this measure of differentials did not change; 1840 being still the peak year.

Over time, the age-distribution of women within child-bearing ages in the United States changed in such a way as (1) to increase the number of women in the middle age-groups (20-29 and 30-39) at the expense of the very young (16-19) and the very old (40-49) age-groups and (2) to increase the older ages at the expense of the younger. The proportion of women who belonged to the two middle age-classes (20-29 and 30-39) in the United States increased from 60.8% in 1830 to 61.7% in 1860, and the proportion of women belonging to the two older age-classes (30-39 and 40-49) increased from 37.6% in 1830 to 41.0% in 1860. Both of these changes tended to increase the unstandardized refined birth-ratio. Therefore, the decline of fertility over time was somewhat greater than that shown by the decline in the unstandardized refined birth ratio. According to our calculation, the standarized refined birth ratio declined 20.1% between 1830 and 1860, whereas the unstandardized ratio declined only 17.5%.

6. *Summary*

In this chapter the effects of the age-distribution of women within child-bearing ages and, particularly, of the marriage customs of women on differentials and trends in the birth rates or birth ratios were examined. It is well known that the fall in the birth rate in Ireland after the middle of the nineteenth century was caused by a fall in the incidence of marriage and a rise in the age at marriage. Several other cases where marriage customs played a part in creating differentials and trends in the birth rates have been reported.

In the New World, or European cultural area overseas, the effect of marriage customs was particularly important. For one thing, much, though not all, of the difference between the birth rates of the New World and the Old in the early decades of the nineteenth century or earlier can be explained by a difference in marriage customs. For another, the difference in the birth rates in different localities of comparable rurality within the United States in comparable periods can also be accounted for largely by marriage customs. In the third place, a considerable part of the fall in the birth rate in the New World in early years is attributable to the rise in age at marriage and the fall in the incidence of marriage. In Australia and Canada, the fall in intramarital fertility apparently did not begin until the closing decades of the nineteenth century. In the United States the fall in intramarital fertility started earlier but the contribution of the change in marriage customs towards reducing the refined birth rate seems to have been considerable.

A hypothesis presented by H. Yuan T'ien attributes a part of the variations of the fertility ratios of American States and territories in the early nineteenth century to the variations of the sex ratios. It was explained that in areas where the ratio of men to women was high the proportions of women marrying would be larger and, hence, the ratios of children to women of child-bearing age would also be larger than in areas where the ratio of men to women was low. Although this theory is not unreasonable, it does not seem to have been the major explanation of the differentials and changes in the refined birth ratios in the United States between 1800 and 1860. The differentials in the sex ratios of states and territories do not appear to have been

large enough to cause the wide differentials in the refined birth ratios and there were no definite trends over time in the sex ratios in most states.

The effect of the age-distribution upon the refined birth ratios was to mask the differentials of fertility at a point of time and the changes in fertility over time. When the refined birth ratios were standardized for age-distribution, their relative levels in states in the northern Atlantic area and states and territories in the frontier areas became lower, while the relative levels of the change in marriage customs towards reducing the refined birth ratios in the South and the older Midwestern states became higher. As a result the differentials in the birth ratios measured by the weighted mean deviation of the refined birth ratio became somewhat larger when the ratios were standardized. However, the ranks of states and territories with respect to the refined birth ratio remained largely the same.

Over time, the changes in the age-distribution tended to offset partially the fall in fertility. When the refined birth-ratio for the United States was standardized, it declined 20.1% between 1830 and 1860 instead of 17.5% which was the rate of decrease of the unstandardized ratio.

Chapter V

SOCIO-ECONOMIC EXPLANATIONS OF BIRTH RATES

In Chapter IV, it was shown that a considerable part of the decline in the birth rate in the United States in the nineteenth century is attributable to less frequent and later marriages by American women. This change in marriage customs, however, is only a direct cause of the decline in fertility and we now have to look for what caused the change in marriage customs itself. The change in marriage customs moreover can explain only a part, probably a smaller part, of the decline in fertility; the rest, which was directly due to the reduction of intramarital fertility, must also be accounted for.

In this chapter, what little statistical date there are on socio-economic conditions in the United States in the period 1800-1860 are analyzed in relation to the levels and trends in the refined birth ratios. Of course, there are many other factors, cultural, religious and physiological, which may have affected the fertility of American women. All we want to do here is to see whether certain hypotheses that explain the levels and trends in fertility in terms of some socio-economic variables are sustainable by statistical evidence.

1. *Industrialization and Urbanization*

Most writers on the question of the declining birth rate in the western world believe that industrialization and urbanization are the prime movers of the social and cultural changes which induced individuals to limit the size of the family either through prolonged celibacy or through contraception and abortion.

Urban life is presumably detrimental in a number of ways to the raising of a large family. First, the direct money cost of raising children is greater in cities. Not only are the prices of

many necessaries of life for children higher there but the real cost of children is also higher, for it requires a greater amount of preparation to make city children ready for industrial jobs than to prepare rural youths for farm life. Moreover, the value of children as earning assets is much smaller in modern cities than it was in rural areas in the early nineteenth century. The change in the usefulness of children is particularly great in the United States about which it was once said that "a numerous family of children, instead of being a burden, is a source of opulence and prosperity to the parents." [1] In modern cities, in order to contribute to the income of the household, children usually have to be employed outside the family, and such employment is very often restricted by law, by custom, and by the demands of technology.[2]

Secondly, in cities women are usually employed, if at all, outside of their homes and this tends to discourage large families in several ways. For one thing, in cities the care of children almost totally deprives mothers of the opportunity of earning income, whereas on the farm it interferes less with the farm wife's activities. For another, the increased opportunity of employment for women outside the home in modern cities gives them greater independence both before and after marriage. Before marriage "a woman capable of making her own living is not so easily satisfied in the matter of a husband as was formerly the case." [3] As a result, more and more women postpone marriage or do not marry at all, and the average number of children becomes smaller.[4] Furthermore, it is quite likely that wives capable of earning income have more to say about having chil-

[1] Adam Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations,* Modern Library edition, ed. by Edwin Cannan, New York 1937, p. 70.

[2] Wilson H. Grabill, Clyde V. Kiser, and Pascal K. Whelpton, *The Fertility of American Women*, New York 1958, p. 83; Warren S. Thompson, *Ratio of Children to Women: 1920*, Census Monograph XI, Washington 1931, pp. 129-130; Bernard Okun, *Trends in Birth Rates in the United States since 1870,* Baltimore 1958, p. 166; R. F. Harrod, "Modern Population Trend," *The Manchester School*, 1939, 10, p. 13; Weld A. Rollins, "The Effect of Immigration on the Birth Rate of the Natives," *The Journal of Heredity*, September 1930, 21, pp. 390-391; W. J. Martin, "Studies in the Declining Birth-Rate, England and Wales," *Journal of Hygiene,* October 1937, 37, p. 505.

[3] John B. Phillips, "The Declining Birthrate," *The University of Colorado Studits*, March 1910, 7, p. 174.

[4] The validity of this part of the hypothesis is discredited by most present-day demographers. The thesis certainly does not apply to the West of the twentieth century.

dren than wives tied to unpaid farm work and housework and, since it is women who bear most of the burden of raising children, not to speak of the burden of pregnancy and delivery, it is natural that more families restrict the number of children.[5]

Thirdly, the availability of a wider range of goods and services, a more competitive and mobile social structure, and more advanced and wider education have bred materialistic and rational philosophy among city dwellers. A premium has been placed on individual enjoyment and whatever inhibitions people had against the idea of artificially controlling the number of their offspring have been weakened.[6]

Fourthly, information on contraceptive techniques is likely to be more readily available in cities, since city dwellers are prone to exchange information more widely and to be more exposed to communication media.[7]

The theories summarized above are all concerned with the voluntary limitation of the number of children either through postponement of marriage or through reduction of intramarital fertility. Another line of thought attributes the decline in fertility to a biological change in men and women. According to this theory, greater mental and nervous strain has made the modern dwellers in urban communities physically less fit for procreation. This is a possible explanation, and an increase in the ratio of infecund women over time as well as a higher incidence of infecundity in cities than in rural areas may be taken as evidence in favor of the thesis.[8] However, most writers of

[5] Okun, *op. cit.*, pp. 166, 167-168; Edward A. Ross, "Western Civilization and the Birth-Rate," *Publications of the American Economic Association,* February 1907, 8, p. 81; T. H. Marshall, "The Population of England and Wales from the Industrial Revolution to the World War," in E. M. Carrus-Wilson, ed., *Essays in Economic History*, London 1954, p. 337; Roderich von Ungern-Sternberg, *The Causes of the Decline in Birth-Rate within the European Sphere of Civilization*, trans. by Hilda H. Wullen, Cold Spring Harbor, N. Y. 1931, p. 168.

[6] Okun, *op. cit.*, p. 168; Ross, *loc. cit.*, pp. 80-81; Ungern-Sternberg, *op. cit.*, pp. 89-91; Joseph J. Spengler, *France Faces Depopulation,* Durham, N. C. 1938, pp. 285-286.

[7] A. J. Jaffe, "Urbanization and Fertility," *The American Journal of Sociology,* July 1942, 48, p. 58; Thompson, *op. cit.*, pp. 58, 70.

[8] Cyrus Edson, "American Life and Physical Deterioration," *The North American Review*, October 1893, 157, pp. 448-450; J. L. Brownell, "The Significance of a Decreasing Birth-Rate," *Annals of the American Academy of Political and Social Science,* July 1894, 5, pp. 64-65, 89; P. K. Whelpton, "Causes of the Decline in Birth Rates," *The Milbank Memorial Fund Quarterly,* July 1935, 13, p. 239; Herbert Spencer, *The Principles of Biology*, Vol. 2; New York 1867, pp. 485-486.

today seem to be of the opinion that the voluntary control of the number of children is the more important cause of the decline in fertility.[9] Even the increase in infecundity has been viewed as largely the result of voluntary control.[10]

It is well known that in all the countries of the West which went through industrialization and urbanization, the birth rate went down whatever its direct cause may have been.[11] The United States is no exception. The question with which we are here concerned is whether urbanization and industrialization can explain the fall in fertility in as early a period as the first half of the nineteenth century.

Two indices of industrialization and urbanization are shown in Tables V-1 and V-2. The proportion of workers gainfully employed in non-agricultural pursuits increased from 28.1% in 1820 to 41.0% in 1860, to 63.2% in 1900, and to 83.1% in 1940.

[9] Thompson, *op. cit.*, pp. 38-39; Whelpton, *loc. cit.*, p. 245.

[10] Grabill et al., *op. cit.*, p. 347.

[11] Some writers have contended that the decline in mortality following industrialization was the cause of the decline in fertility. According to their theory the improvement in nutrition, public health services and medical care as a result of the rise in income caused the fall in mortality, particularly infant mortality. This meant an increase in the number of children whom parents had to raise to adulthood. Seen from a different viewpoint, the number of births necessary to bring a certain number of children to maturity became smaller. Hence, so the theory goes, parents were motivated to restrict the number of births and, when contraceptive techniques became available, did actually limit the number of births. (T. H. Marshall, "The Population Problem during the Industrial Revolution: A Note on the Present State of the Controversy," in E. M. Carrus-Wilson, ed., *Essays in Economic History*, London 1954, p. 311; Everett E. Hagen, "Population and Economic Growth," *American Economic Review*, June 1959, 49, p. 319.)

Presumably the lengthening of adult life also contributed to the decline in fertility in the late pre-industrial or early industrial period. For rural youths tended to marry only when they acquired land to live on, and this was postponed by the added life span of their fathers. (Per Goran Ohlin, *The Positive and the Preventive Check: A Study of the Rate of Growth of Pre-Industrial Populations,* unpublished Ph. D. dissertation, Harvard University, September 1955, p. 421.)

The reasoning is plausible and historically in most countries the decline in mortality led to a decline in fertility. Crosssectionwise there is also some evidence to indicate that higher mortality was associated with higher fertility in pre-industrial and early industrial society. (Ohlin, *op. cit.*, pp. 417-418; Eli F. Heckscher, *An Economic History of Sweden*, trans. by Göran Ohlin, Cambridge 1951, p. 146; Gustaf Utterström, "Some Population Problems in Pre-Industrial Sweden," *The Scandinavian Economic History Review*, 1954, 2, pp. 154, 158.) But this theory does not seem to be supported by statistical data in the United States before the Civil War. As we saw in Chapter III mortality probably did increase in this period while fertility continued to decline. Again mortality in cities was definitely and much higher than in rural areas whereas the fertility was lower in the former than in the latter as we shall presently see.

TABLE V-1

PROPORTION OF WORKERS GAINFULLY EMPLOYED IN NON-AGRICULTURAL PURSUITS IN THE UNITED STATES, 1820-1940

1820	28.1%	1880	50.5%
1830	29.5	1890	57.9
1840	31.4	1900	63.2
1850	36.4	1910	69.1
1860	41.0	1920	73.3
1870	46.9[a]	1930	78.5
1870	50.2[b]	1940	83.1

Note: *a*. Comparable with data for earlier years. *b*. Comparable with data for later years.
Source: U. S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1957*, Washington 1960, p. 74.

TABLE V-2

PROPORTION OF PERSONS LIVING IN URBAN AREAS IN THE UNITED STATES, 1790-1950

1790	5.1%	1880	28.2
1800	6.1	1890	35.1
1810	7.3	1900	39.7
1820	7.2	1910	45.7
1830	8.8	1920	51.2
1840	10.8	1930	56.2
1850	15.3	1940	57.1
1860	19.8	1950	58.7
1870	25.7		

Source: *Ibid*., p. 14.

Similarly the proportion of persons living in urban areas[12] increased from 5.1% in 1790 to 19.8% in 1860, and to 58.7% in 1950. These figures certainly indicate a great socio-economic change. However, when we look closely at the table from which they come, we will see that the paths of industrialization and urbanization were not smooth and steady from the beginning of

[12] Urban area is defined by the 1940 Census to include (1) "cities and other incorporated places having 2,500 inhabitants or more," (2) New England townships "in which there is a village or thickly settled area having 2,500 inhabitants or more and comprising, either by itself or when combined with other villages within the same town, more than 50% of the total population of the town," and (3) "townships and other political subdivisions (not incorporated as municipalities, nor containing any areas so incorporated) with a total population of 10,000 or more and a population density of 1,000 or more per square mile."

the nineteenth century. Both tables show that the change was very gradual until around 1840 and then suddenly became accelerated. They also show that the level of industrialization and urbanization before 1840 was very low. The proportion of workers in non-agricultural employment in this period was no higher than in European countries in the early nineteenth century, or earlier,[13] and the proportion of the urban population was very low. There is no doubt that the country was predominantly agricultural. Yet fertility started to decline at latest at the beginning of the nineteenth century and probably much earlier. It is true that the refined birth ratio fell very rapidly between 1840 and 1850 when the process of industrialization-urbanization was accelerated, but in view of the relatively large underenumeration of children in 1850, which tended to reduce the refined birth ratio for that year, it does not seem to be appropriate to attach much significance to this fact.

To gain a deeper insight into the relationship between industrialization - urbanization and fertility, the association between them was analysed by state or territory. Table V-3 shows the degree of urbanization of each state in each of the census years between 1800 and 1860. The degree of urbanization seems to be inversely similar to that of white fertility. Urbanization was most advanced in the lower New England and Middle Atlantic states throughout the period. The South Atlantic states were at first more urban than the inland states and territories but in them the progress of urbanization was rather slow so that some of the Midwestern states had caught up with them by the end of the period. Naturally frontier areas in any period tended to be among the least urban.

Ranking states and territories in the order of their white refined birth ratio, or the number of white children under 10 per 1,000 white women aged 16-44,[14] and in the order of their proportion of urban population, we computed Kendall's coefficient of rank correlation (τ) for each census year (Table V-4).

[13] The proportion of the labor force (excluding women in agriculture), employed in agriculture, fishing, and forestry was 62.5% in Sweden in 1840 and 63.0% in France in 1827. (Colin Clark, *The Conditions of Economic Progress,* 3rd ed., London 1957, pp. 513, 514, 519.) Apparently the proportion of the labor force in agriculture in Sweden had changed little since the middle of the eighteenth century. (Eli F. Heckscher, *op. cit.*, p. 142.)

[14] Throughout this chapter the *standardized* ratio of children to women was used for 1830 and later unless noted otherwise.

TABLE V-3

PROPORTION OF URBAN POPULATION BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	2.4%	2.9%	2.9%	7.8%	7.8%	13.5%	16.6%
New Hampshire	2.9	3.2	3.0	5.0	10.0	17.1	22.1
Vermont	0	0	0	0	0	1.9	2.0
Massachusetts	15.4	15.4	22.8	21.3	37.9	50.7	59.6
Rhode Island	20.8	23.4	23.0	31.2	43.8	55.6	63.3
Connecticut	5.1	6.1	7.6	9.4	12.6	16.0	26.5
Middle Atlantic							
New York	12.7	12.7	11.7	14.9	19.4	28.2	39.3
New Jersey	0	2.4	2.7	5.7	10.6	17.6	32.7
Pennsylvania	11.3	12.8	13.0	15.3	17.9	23.6	30.8
South Atlantic							
Delaware	0	0	0	0	10.7	15.3	18.9
Maryland	7.8	12.2	16.3	20.4	24.2	32.3	34.0
Virginia	1.8 [b]	2.5 [b]	2.6 [b]	3.5 [b]	5.7 [b]	7.1	8.5
North Carolina	0	0	2.0	1.4	1.8	2.4	2.5
South Carolina	5.4	6.0	4.9	5.8	5.7	7.3	6.9
Georgia	3.2 [a]	2.1	2.2	2.7	3.6	4.3	7.1
Florida				0	0	0	4.1
East North Central							
Ohio	0 [a]	1.1 [b]	1.7	3.9	5.5	12.2	17.1
Indiana	0 [a]	0 [b]	0	0	1.6	4.5	8.6
Illinois		0 [a]	0	0	2.0	7.6	14.3
Michigan		0 [a]	0 [a]	0 [a]	4.3	7.3	13.3
Wisconsin					0 [a]	9.4	14.4
East South Central							
Kentucky	0	1.1	1.6	2.4	4.0	7.5	10.4
Tennessee	0	0	0	0.8	0.8	2.2	4.2
Alabama			0	1.0	2.1	4.6	5.1
Mississippi	0 [a]	0 [a]	0	2.0	1.0	1.8	2.6
West North Central							
Minnesota						0 [a]	9.4
Iowa					0 [a]	5.1	8.9
Missouri			0 [a]	3.5	4.3	11.8	17.2
Dakota							0
Nebraska							0
Kansas							9.4
West South Central							
Arkansas			0 [a]	0	0	0	0.9
Louisiana		22.5 [a]	17.7	21.4	29.9	26.0	26.1
Texas						3.6	4.4

State or territory	1800	1810	1820	1830	1840	1850	1860
Mountain							
Colorado							13.9
New Mexico						7.4[a]	5.0
Utah						0[a]	20.5
Nevada							0
Pacific							
Washington							0
Oregon						0[a]	5.5
California						7.4	20.7

Note: *a.* These figures are not comparable with later figures because of territorial changes. *b.* These figures are not strictly comparable with later figures for the same reason. But the territorial changes involved are rather minor in these cases and are disregarded in the analysis in the text.

Source: U. S. Bureau of the Census, *Sixteenth Census of the United States, 1940—Population*, Vol. I, *Number of Inhabitants*, Washington 1942, pp. 20-24.

TABLE V-4

KENDALL'S COEFFICIENT OF RANK CORRELATION BETWEEN THE WHITE REFINED BIRTH RATIO[a] AND THE PROPORTION OF URBAN POPULATION IN A STATE OR TERRITORY: UNITED STATES, 1800-1860

	1800	1810	1820	1830	1840	1850	1860
All states & territories	–.468*	–.360*	–.544**	–.409**	–.495**	–.593**	–.366**
States only	–.410*	–.428*	–.520**	–.407*	–.584**	–.616**	–.538**
Free states & territories	–.674*	–.587*	–.507*	–.427*	–.541**	–.553**	–.355*
Slave states & territories	–.261	–.024	–.556*	–.169	–.544**	–.708**	–.543**

Note: *a.* The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44. * Significant at the 5% level of probability. ** Significant at the 1% level of probability.

The coefficients are all negative and fairly high (between —.360 and —.593). All of them are significant at least at the 5% level of probability and the last five at the 1% level. Some of the territories with unusually and temporarily low fertility disturb the relationship particuarly in later years. When the correlation is computed for states only, the coefficient improves consider-

ably in 1810, 1840, and 1860, though it becomes somewhat lower in 1800.

Lest the existence of large non-white population in the South should have exerted an influence on the relationship, the association of the two variables was examined separately for slave and non-slave states and territories.[15] The coefficient of rank correlation for non-slave states and territories turned out to be considerably larger (in absolute value) than the coefficient for all states and territories in the first two census years and about the same as the coefficient for all areas in other years. All are significant at least at the 5% level. For slave states, however, the coefficient changed rather erratically in the early years, and the correlation for 1800. 1810, and 1830 are not significant at the 5% level of probability. This is probably due to the generally agrarian character of the South rather than to the existence of a large Negro population. With the exception of Louisiana and Maryland, the proportion of the population that was urban in each of the Southern states was less than 6% in 1830, and naturally this proportion varied little from state to state. In later years, the coefficient became larger, even larger than for the non-slave states. Thus, cross-section analysis supports the hypothesis that urbanization is inversely related to fertility.

If urbanization was the major force in reducing fertility in this period, we should expect not only that those states with a greater proportion of urban population would have lower fertility but also that the states which experienced a greater increase in the proportion of urban population would show a greater decline in fertility. To test this hypothesis, following the conventional method, the coefficient of rank correlation between the absolute increase in the proportion of urban population and the absolute decrease in fertility in a state or territory as well as the coefficient for the relative increase in the former and the relative decrease in the latter were computed.[16] τ for the absolute changes [17] in both variables between 1800 and 1860 turned out to

[15] Slave states or territories are defined as states or territories in which there were slaves in 1860, with the exception of Utah and Nebraska, which are counted among non-slave states despite the existence of a few slaves in 1860.

[16] In case of ties in absolute change, the state which ranked higher in relative change was given a higher rank and, in case of ties in relative change, the state which ranked higher in absolute change was given a higher rank.

[17] Since the direction of the change over time in any one variable analyzed in this chapter was *always* the same, we decided, for semantic reasons, to neglect the signs

be —.266 and τ for the relative changes .333. The two results are conflicting and not significant at the 5% level. Classifying states and territories into slave and non-slave did not help at all. Suspecting, however, that a significant association in the last half of the period might be confounded by a weak association in the first half, the rank correlation coefficient was computed separately for 1800-1830 and 1830-1860. For 1800-1830 the coefficient for the absolute changes in both variables is .200 and that for the relative changes .067. For 1830-1860 the coefficients are respectively —.380 and .146. None except the coefficient for the absolute changes between 1830 and 1860, which is negative and significant at the 5% level of probability, is statistically significant. Thus, it may seem either that there is no definite relationship between the increases in the degree of urbanization and the declines in fertility or that the relationship is an inverse one.

However, this peculiar result seems to have come from a methodological defect inherent in this type of analysis. One of the major reasons for using the rank correlation method instead of the ordinary correlation method is that in the former it is not necessary to make any assumption about the functional relationship of the two variables to be examined except that the relationship is monotonic. But when we apply the rank correlation method to incremental variables, we can no longer enjoy this advantage, for, by doing so, we are making a tacit assumption as to the functional, not just the ordinal, relationship between the two original variables, in this case between the proportion of the urban population and fertility. For example, when we apply the rank correlation method to the relationship between the absolute changes in the two variables, it may be said that we are testing a hypothesis that urban and rural fertilities were constant over time and that the shift of population from rural to urban areas caused the general decline in fertility.[18]

of the changes. Thus, a positive correlation means that the larger the absolute value of the change in one variable (e. g., increase in the proportion of urban population), the larger the absolute value of the change in the other variable (e. g., decrease in fertility).

[18] If urban fertility is f, rural fertility αf and the proportion of urban population u, the fertility for the whole country $(\bar{f})$ is

$$\bar{f} = fu + \alpha f(1 - u) = f\{(1 - \alpha)u + \alpha\} \text{ and } \Delta\bar{f} = f(1 - \alpha)\Delta u.$$

According to this model we would expect that the greater the absolute change in the proportion of urban population, the greater the fall in fertility, irrespective of the initial level of fertility and the initial degree of urbanization.

This hypothesis must be rejected. If urban and rural fertilities had not changed over time, the number of white children under 5 per 1,000 white women aged 20 to 44 in the United States would have declined from 1281 in 1800 to 1245 in 1860 instead of to 886 as they actually did. Only 9% of the decline in fertility in this period can be attributed to the shift of population from rural to urban areas.[19]

However, it is much more sensible to look at the proportion of urban population as an index of urbanization. Looked at in this way, the functional relationship between the proportion of urban population and fertility may be curvilinear. The hypothesis that a relative change in the former is associated with a relative change in the latter (the case of a constant elasticity) is only one of many possible hypotheses, and only a cursory look at Figure 2 reveals that this hypothesis is not appropriate. Whereas the curve (when the function is a decreasing one) should according to the hypothesis be a type expressed by $y^a x^b = c$ with X and Y axes as asymptotes, scattered dots on the Figure give the impression that the asymptotes are the Y axis and a horizontal line well above the X axis.

As an experiment, the horizontal asymptote was asssumed to be $y = 600$ and the association between the proportion of urban population and the number of children per 1,000 women minus 600 was examined. The coefficient of rank correlation between this modified relative decline in fertility and the relative increase in the proportion of urban population in a state or territory is .200 for 1800-1830 and .170 for 1830-1860 and neither is significant at the 5% level of probability. However, the association between the modified relative decline in fertility and the absolute increase in the degree of urbanization turned out to be somewhat higher, .277 for 1800-1830 and .327 for 1830-1860. The latter is significant at the 5% level but not at the 1% level.[20]

This result is diametrically opposite to the negative and significant association between the absolute decline in fertility and

[19] Figures are from U. S. Bureau of the Census, *Historical Statistics of the United States, Colonial Times to 1957,* Washington 1960, p. 24.

[20] Without the modification of fertility figures, the coefficients of rank correlation for all combinations of relative change in one of the two variables and absolute change in the other were computed. None of the coefficients of rank correlation turned out to be significant.

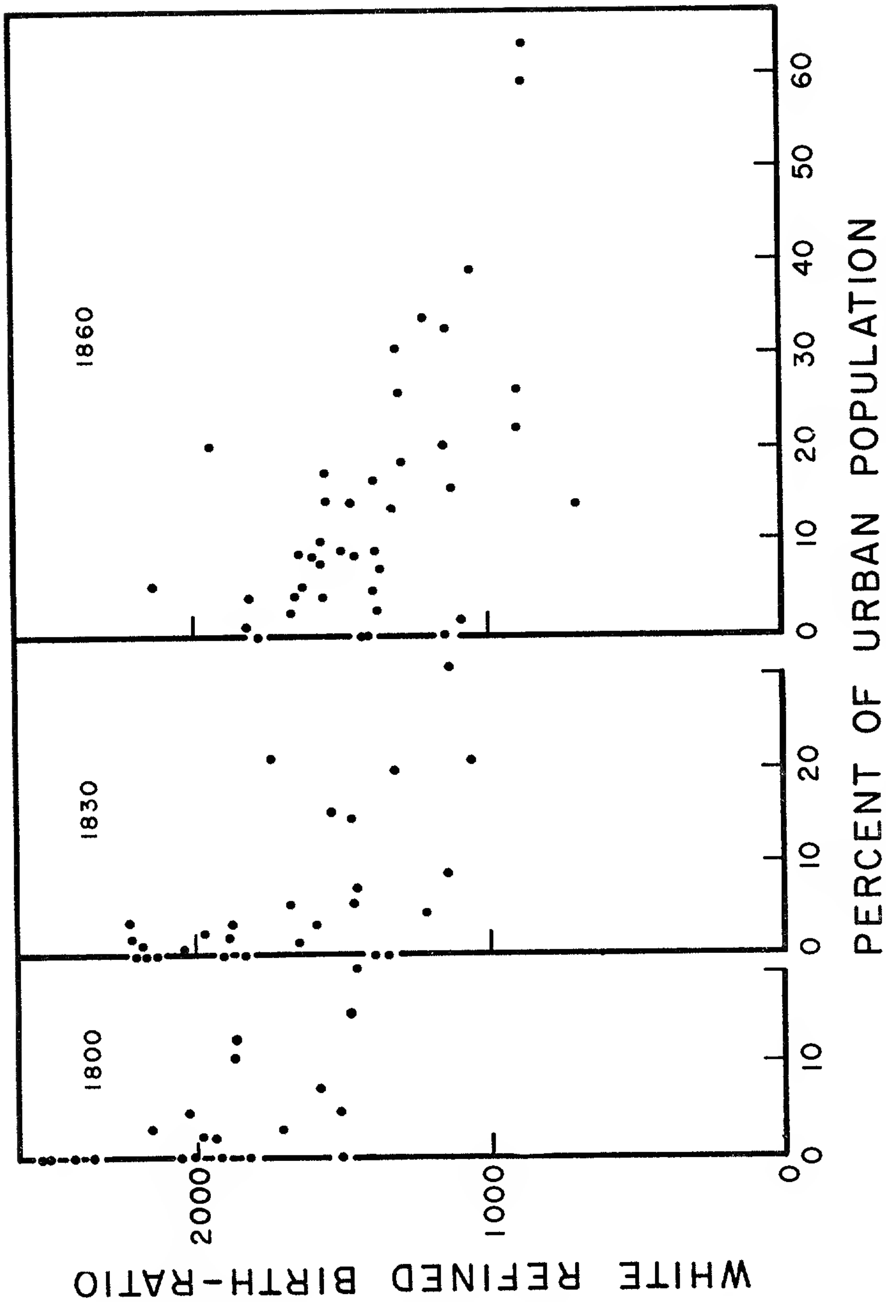

FIG. 2. White Refined Birth Ratio and Percent of Urban Population in a State or Territory: United States, 1800, 1830 and 1860

the absolute increase in the proportion of urban population in a state between 1830 and 1860 and it may seem that no definite conclusion can be drawn from the analysis. However, the negative association between the absolute changes in both variables may be shown to be the logical consequences of a real positive association.

The functional relationship between two original variables seems to be expressed by $(y + a)\ x^b = c$ or $y = ab^x + c$. If the former is the case, a state originally with a large value in y and a small value in x tends to show a larger absolute decline in y and a smaller absolute increase in x than a state in the opposite position if there is no association between the original values of x and its relative changes. For the same relative change in x means a larger absolute change for a state with an initially larger value of x and a smaller value of y, and the same relative change in $(y + a)$ which will be induced by the same relative change in x means a larger absolute change in y for a state with an initially smaller x and a larger y. In the case of $y = ab^x + c$, the reasoning is similar, but to produce an inverse association between the absolute changes in both variables, the absolute increase in x of a state with an initially larger value of x has to be moderately, but not excessively, larger than the absolute increase in x of a state with an initially smaller value of x. What actually happened is probably closer to the lattter case.

This does not prove that the positive correlation between the absolute change in the degree of urbanization and the modified (— 600) relative change in fertility is meaningful and the negative correlation between the absolute changes in both variables spurious. It merely suggests that such an interpretation is possible and, it might be added that the scatter diagram suggests this may be probable.

The best way to test whether this interpretation is indeed correct, it seems to us, is to standardize the sample according to the original level either of fertility or of urbanization, and to analyse the relationship between increments in each variable within a stratum. Since each variable is continuous, a method which might be called moving standardization was used. As shown in the first column of Table V-5 states and territories were arrayed in the order of their fertility in the initial year from low to high. The second and third columns show the rank of states

with respect to their absolute decline in fertility and to their absolute increase in the proportion of urban population. The next three columns compare the states in these matters. The first compares two neighboring states. If the two states rank in the same order in both incremental variables, as do Massachusetts and Delaware in 1800-1830, o appears in the space right of the upper state in the column marked I. If they rank in different order as do Rhode Island and Massachusetts in 1800-1830, x appears in the space. The second column similarly compares states two positions apart, and the third column states three positions apart, and so on. In the final few columns a similar comparison is made between the absolute decrease in fertility and the

TABLE V-5

ANALYSIS OF THE ASSOCIATION BETWEEN THE CHANGE IN THE WHITE REFINED BIRTH RATIO[a] AND THE CHANGE IN THE PROPORTION OF URBAN POPULATION IN A STATE OR TERRITORY: UNITED STATES, 1800-1830 AND 1830-1860

A. 1800-1830

States and territories in the order of birth ratio in 1800	Rank of a state or territory with respect to absolute decline in fertility, 1800-1830	Rank of a state or territory with respect to absolute increase in the proportion of urban population, 1800-1830				Rank of a state or territory with respect to relative increase in the proportion of urban population, 1800-1830		
			I	II	III		I	II
Rhode Island	13	2	x	o	x	6	x	o
Massachusetts	5	3	o	o	x	7	x	x
Delaware	16	15.5	o	o	o	....		
Connecticut	7	7	x	x	x	4	x	x
Maryland	14	1	x	x	x	2	x	x
New Hampshire	3	10	x	x	x	5	o	o
New Jersey	10	4	x	x	o	....		
New York	6	8	x	o	o	9	x	x
Pennsylvania	12	6	o	x	o	8	o	o
North Carolina	15	12	o	o	o	....		
Virginia	9	11	o	o	x	3	o	o
Maine	2	5	o	x	o	1	o	
South Carolina	11	14	x	o	o	10		
Vermont	1	15.5	x	x		....		
Kentucky	4	9	o			....		
Tennessee	8	13				....		
Total			o = 21, x = 21			o = 8, x = 9		

B. 1830-1860

States and territories in the order of birth ratio in 1830	Rank of a state or territory with respect to absolute decline in fertility, 1830-1860	Rank of a state or territory with respect to absolute increase in the proportion of urban population, 1830-1860	I	II	III	IV	Rank of a state or territory with respect to relative increase in the proportion of urban population, 1830-1860	I	II	III
Massachusetts	23	1	x	x	x	o	8	o	x	o
Connecticut	21	7	o	o	o	x	7	x	o	o
Rhode Island	20	2	x	o	x	o	13	o	o	o
New Hampshire	17	6	o	x	x	o	4	o	o	x
Maryland	25	10	x	o	o	x	16	o	o	o
Vermont	13	21	x	x	x	o	....			
Delaware	24	5	o	x	o	x	....			
New Jersey	14	3	o	x	o	o	1	o	x	o
Maine	15	12	o	x	o	o	12	o	o	x
New York	10	4	o	o	o	o	9	o	o	o
Pennsylvania	19	8	o	x	x	x	14	x	x	x
Virginia	22	15	x	x	x	o	11	x	x	x
North Carolina	16	22	x	o	o	x	15	x	x	o
South Carolina	12	23	o	o	x	o	19	o	o	o
Louisiana	7	16	o	o	x	o	18	o	x	x
Ohio	5	11	o	o	o	x	5	o	o	o
Florida	18	18	o	o	x	x	....			
Kentucky	11	14	x	x	x	o	6	x	o	x
Georgia	9	17	x	x	o	o	10	o	x	o
Tennessee	4	20	o	o	o	o	2	o	x	
Mississippi	6	25	o	o	o	x	17	o		
Indiana	3	13	o	x	o		....			
Illinois	1	9	o	o			....			
Alabama	2	19	o				3			
Arkansas	8	24					....			
Total			o = 53, x = 37				o = 32, x = 19			

Note: *a*. The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44.

relative increase in the proportion of urban population.[21] More or less arbitrarily, it was decided that states and territories two positions or less apart were to be matched when their number was 10 or less. Likewise, to be matched were states and terri-

[21] Matching of the relative change in fertility and the relative or absolute change in urbanization was not tried, because it was expected that the rank of a state with respect to the absolute and relative changes in fertility would be more or less the same *within a stratum*.

tories three positions or less apart, when their number was more than 10 but not more than 20, four positions or less apart, when their number was between 20 and 30, and so on.[22]

In the period 1800-1830, the numbers of "rights" (o's) and "wrongs" (x's) are about the same in both associations and we are induced to conclude that in this period urbanization was not an important factor in reducing fertility.

In the period 1830-1860, however, there is a considerable tendency for "right" combinations to outnumber "wrong" combinations in both associations. In the association between the absolute changes in both variables the order of the two rankings are the same in 53 out of 90 matches (58.9%).[23] In the association between the absolute change in fertility and the relative change in the proportion of urban population 32 matches out of 51 are in the right order (62.8%). If we compute the ratio of the difference between rights and wrongs to the total matches we get something similar to τ. We might call it the coefficient of standardized rank correlation, and designate it by τ_s. τ_s in this case is .178 for the absolute change in the degree of urbanization and .255 for the relative change. Unfortunately, the variance of the coefficient is not known and it is not possible to tell how significant these results are. All we can say is that this result suggests a hypothesis that urbanization was not an important factor in reducing the fertility of American women between 1800 and 1830 but that it became more important in the next thirty years.

So far we have compared the change in the degree of urbanization between two census dates 30 or 60 years apart, and the change in fertility between two ten-year periods each directly preceding these census dates. When the period is such a long one as 60 years, the change between census dates and the change between decades preceding these census dates would not be very different. However, when the period is 30 years, a lag of about 5 years may be of some significance. Moreover, if the relationship between urbanization and the fall in fertility is causal, we might expect that the change in the latter lagged behind the change in the former.

[22] In general terms, if the number of states and territories is between $10(n-1)$ and $10n$, n being an integer, states and territories $(n+1)$ positions or les apart in ranking with respect to the standardized variable are matched.

[23] Notice that the overall τ was negative and significant.

Therefore, the decline in the refined birth ratio between 1800 and 1830 (decline in fertility between 1790-1800 and 1820-1830) was compared with the increase in the degree of urbanization between 1790 and 1820. Similarly, the decline in the refined birth ratio between 1830 and 1860 was compared with the increase in the degree of urbanization between 1820 and 1850. The method of standardized rank correlation was used.

For the first thirty years the association seems to have been, if anything, negative. Standardized with respect to the initial level of fertility, the coefficient of standardized rank correlation between the absolute changes in both variables during the first thirty years is —.122 and the coefficient for the relative change in the proportion of urban population and the absolute change in fertility —.333. The former figure is based upon 16 states and territories, the latter upon only nine. For the latter half of the period, or 1830-1860, r_s is .233 for absolute changes in both variables and .286 for relative change in urbanization and absolute change in fertility.[24]

This result is almost the same as the one obtained when no allowance was made for a time lag, except that for the first half of the period there appear negative associations. Whether this is meaningful we do not know. We do, however, feel that the significance of the relatively large negative coefficient for the relative increase in the degree of urbanization and the absolute decline in fertility should be discounted because of the smallness of the sample size.

We have in the census another set of statistics showing the degree of industrialization; industrial distribution of employed persons. The scope and method of classification were changed from one census to another. In 1820 when a question about occupation was first asked, persons employed, white and colored, were classified into three groups, those engaged in agriculture, those in commerce and those in manufactures. In 1840 a fuller enumeration of the industrial classes was made and persons engaged, white and colored, were classified into one of seven categories, namely, mining, agriculture, commerce, manufactures and trades, ocean navigation, internal navigation, and learned professions and engineers. In these two censuses the scope of

[24] The number of states and territories represented is 24 for the former and 16 for the latter.

those who were to be enumerated was not specified and, as a result, some enumerators included children as young as twelve years of age while other enumerated only persons who were twenty years of age or older. An improvement was made on this point in the census of 1850 and white males over 15 years of age were classified into occupation groups. In the next census the scope of enumeration was again altered and this time both white males and females over 15 years of age were classified. Occupations were divided in these two censuses into a large number of classes but in 1850 a tabulation by broader category was also given for each state and territory.

For each census, the proportion of those employed in non-agricultural activities among total employed persons was computed by state or territory. (Table V-6) In 1820 states and

TABLE V-6

PROPORTION OF PERSONS EMPLOYED IN NON-AGRICULTURAL PURSUITS AMONG TOTAL EMPLOYED PERSONS, BY STATE OR TERRITORY: UNITED STATES, 1820, 1840, 1850 AND 1860

State or territory	1820 Both sexes white and non-white	1840 Both sexes white and non-white	1850 White males over 15 years of age	1860 White males and females over 15 years of age
New England				
Maine	17.9%	26.9%	52.6%	60.9%
New Hampshire	17.3	21.6	49.8	61.4
Vermont	15.4	18.2	47.6	47.1
Massachusetts	42.4	58.7	81.1	85.9
Rhode Island	36.6	60.1	80.5	83.1
Connecticut	29.5	38.5	67.1	73.6
Middle Atlantic				
New York	21.8	33.9	64.7	71.8
New Jersey	30.3	37.4	74.5	76.6
Pennsylvania	32.3	40.0	69.5	71.9
South Atlantic				
Delaware	20.2	25.1	64.3	68.1
Maryland	22.8	28.7	77.1	76.4
Virginia	11.8	18.2	52.2	52.9
North Carolina	7.6	7.8	41.2	45.8
South Carolina	5.4	6.8	39.4	46.0
Georgia	5.3	5.8	32.4	42.3
Florida		16.6	54.5	54.2

State or territory	1820 Both sexes white and non-white	1840 Both sexes white and non-white	1850 White males over 15 years of age	1860 White males and females over 15 years of age
East North Central				
Ohio	15.5	23.8	49.1	53.2
Indiana	5.6	15.3	34.4	40.5
Illinois	9.1	15.2	34.5	49.1
Michigan	28.6	13.4	39.6	47.2
Wisconsin		33.6	47.6	46.1
East South Central				
Kentucky	9.2	16.1	39.8	42.3
Tennessee	7.9	9.0	29.3	39.7
Alabama	5.7	6.3	31.7	40.2
Mississippi	4.1	4.8	33.0	38.3
West North Central				
Minnesota			75.9	47.6
Iowa		20.2	33.5	38.2
Missouri	14.7	13.4	48.9	44.9
West South Central				
Arkansas	6.7	6.3	29.0	32.6
Louisiana	18.5	19.4	75.8	74.4
Texas			41.0	41.1
Mountain				
New Mexico			54.4	
Utah			49.6	
Pacific				
Oregon			56.0	50.1
California			97.3	83.5

Note: (1) Most of the ratios in 1840, 1850 and 1860 were computed by Kenneth W. Masters. (2) Only states are shown for 1860.

Source: 1820, U. S. Census Office, *Census for 1820*, Washington 1821, p. 1; 1840, 1850 and 1860, Kenneth W. Masters, *Population Redistribution in the United States, 1840-1860,* unpublished Ph. D. dissertation, University of Pennsylvania, 1955, p. 146, and U. S. Census Office, *The Seventh Census of the United States: 1850,* Washington 1853, p. lxxx.

territories in the Lower South and in the frontier areas were the most agricultural and the states in the Lower New England and the Middle Atlantic areas were among the most industrial, while the northern New England states and the relatively older Mid-western areas were in the intermediate positions. By 1860 the geographical pattern of industrialization as shown by the pro-

portion of those employed in non-agricultural pursuits changed somewhat but much of the apparent change seems to have resulted from the change in the scope of the census, namely the exclusion of non-whites in the censuses of 1850 and 1860. Since non-whites, particularly those in the South, were mostly in agriculture, their exclusion tended to increase on paper the degree of industrialization in the Southern states. Aside from this there was relatively little change in the geographical pattern of industrialization. Lower New England and Middle Atlantic states were still the nation's most industrial area while the Lower South, except Louisiana and Florida, and frontier areas remained most agricultural.

The geographical pattern seems to be similar to that of urbanization and inversely similar to that of fertility. When states and territories are ranked in the order of their degree of industrialization, or proportion of workers employed in non-agricultural pursuits, and also in the order of their white refined birth-ratio, Kendall's τ between the two rankings is —.551, —.655, and —.558 respectively for 1820, 1840, and 1850. When states only are ranked, the absolute value of the coefficients are still larger, —.577, —.668, —.594, and —.621 respectively for 1820, 1840, 1850, and 1860. All coefficients are significant at the 1% level of probability. Dividing states and territories into slave and non-slave does not change the result very much except in 1820 when the coefficients are reduced considerably (to —.462 for non-slave states and territories and —.487 for slave areas) and are not significant at the 1% level though they are still significant at the 5% level. Except in 1850 the coefficient of rank correlation between fertility and the proportion of those employed in non-agricultural pursuits is greater than the comparable τ between fertility and urbanization. This may reflect the fact that the proportion of those employed in non-agricultural pursuits, being changeable continuously, is a better measure of industrialization and even of urbanization than the proportion of urban population—as defined by the Bureau of the Census—which changes in early periods not gradually with population growth but irregularly with town incorporations.

To compare the effect of urbanization-industrialization before and after the Civil War, data on urbanization and industrialization for 1900 and their changes between 1860 and 1900 were

analyzed. The coefficient of rank correlation between fertility[25] and the level of urbanization in a state or territory[26] in 1900 is —.638 and τ for the association between fertility and the degree of industrialization—the proportion of those engaged in non-agricultural pursuits among total persons 10 years of age and over who were gainfully employed—is —.617. The absolute values of the coefficients are larger than any comparable figures before 1860 except one, and both coefficients are significant at the 1% level.

The association between the change in fertility and the change in the degree of urbanization in a state was found positive and

TABLE V-7

KENDALL'S COEFFICIENT OF RANK CORRELATION BETWEEN THE DECLINE IN THE NUMBER OF WHITE CHILDREN UNDER 5 PER 1,000 WHITE WOMEN AGED 15-49 AND THE INCREASE IN THE PROPORTION OF URBAN POPULATION IN A STATE OR TERRITORY BETWEEN 1860 AND 1900: UNITED STATES, 1860-1900

		Fertility	
		Absolute decline	Relative decline
Degree of urbanization	Absolute increase	.327**	.492**
	Relative increase	.335**	.234

Note: ** Significant at the 1% level of probability.

significant.[27] The coefficients of rank correlation (τ) between all the possible combinations of changes in fertility and in the degree of urbanization (Table V-7) ranged between .234 and .492. All except the association between the relative changes in both variables are significant at the 1% level of probability.

The method of rank correlation with states and territories standardized with respect to the initial level of fertility yields still stronger results. The coefficient of standardized rank correlation was .614 for the absolute change in the proportion of

[25] The number of white children under 5 per 1,000 white women aged 15-49, which was computed by Willcox, was used. U. S. Bureau of the Census, *Proportion of Children in the United States* (*Bulletin 22*), by Walter F. Willcox, Washington 1905, pp. 17-18.

[26] Oklahoma and the Indian Territory are excluded.

[27] The measures of industrialization are not comparable between 1860 and 1900.

urban population and the absolute change in fertility, and .241 for the relative change in the degree of urbanization and the absolute change in fertility.[28] The former coefficient is much larger than any comparable figure for a period before 1860.

The evidence which has been examined so far is neither plentiful nor consistent enough to allow us to draw a clear-cut conclusion, but in summary the following may be said. Throughout the period under consideration, 1800-1860, there existed an inverse association between urbanization-industrialization and fertility. The association was not very close in the early decades, particularly in the South, but became somewhat closer later. In view of the weak correlation between the change in the degree of urbanization and the change in fertility, it is questionable that urbanization was the prime mover of the fall in fertility in the early decades. In later decades the change in the degree of urbanization seems to have been a little more closely associated with the change in fertility, although the degree of association is much smaller than in the period 1860-1900. It appears, therefore, that if industrialization-urbanization played an important role in reducing fertility, it began to do so only towards the end of the period, 1800-1860.[29]

2. *Availability of Easily Accessible Land*

If industrialization and urbanization cannot satisfactorily explain the decline in fertility in the early decades of the nineteenth century and earlier, what alternative explanation can be offered? A possible explanation is the increasing difficulty faced by the

[28] The number of states represented is 32 in each case.

[29] Bernard Okun's conclusion that between 1870 and 1950 "the secular rise in urbanization does *not* appear to be a factor contributing significantly to the secular decline in the refined birth ratio" (Okun, *op. cit.*, p. 58. Also cf. p. 63.) seems a bit hasty. In our opinion, he lost too much information by using averages for the two sub-periods, 1870-1910 and 1910-1950. It is true that he later made a more detailed analysis of the second sub-period but somehow he did not consider separately the period before 1910 for which he would probably have found a significant association between urbanization and the fall in fertility.

Though a definite conclusion can be given only upon a more detailed analysis which is beyond the scope of this study, it is likely that the association between the change in urbanization and the change in fertility became closer during the nineteenth century before the trend was reversed sometime either in the late nineteenth or early twentieth century.

average person in obtaining new land not far from the place where he lived. In a predominantly agricultural society, land constitutes the major, if not the sole, economic opportunity, and its relative scarcity may affect the life of the society profoundly.

There are many examples where the availability of farmland very likely affected the marriage customs of an agricultural population.[80] People in communities with high adult mortality tended to marry relatively young presumably because their fathers died relatively young, leaving their farms to their sons. Again, people in sparsely populated areas in Europe and the New World are known to have married very early.

Furthermore, in a community where the supply of land is limited, the value of children as earning assets is low and hence the demand for children may not be so great as where there is plenty of open land nearby. The increased cost of setting up children as independent farmers and fear of the fragmentation of family farms may further encourage the restriction of family-size in densely populated areas.

In the United States, at least until the end of the period under consideration, there was always an expanse of free, or nearly free, land west of the settled areas. Even in the eastern seaboard areas the extent of land-use was more limited than in western Europe. This fact is believed to explain why marriages were earlier and more general and why marital fertility was higher in the United States — even in the eastern sections — than in Europe. However, in the United States, as time passed, the acquisition of new land in the settled areas became increasingly difficult and costlier and the average distance from the settled to the new areas where land was plentiful became farther. Consequently, fertility in the older communities may have been reduced directly in response to the decreased demand for children or indirectly as a result of the rise in the age at marriage and the fall in the incidence of marriage.

In order to test the hypothesis that fertility was inversely asso-

[80] Per Goran Ohlin, *The Positive and Preventive Check: A Study of the Rate of Growth of Pre-Industrial Population*, unpublished Ph. D. dissertation, Harvard University, September 1955, pp. 69, 417-418, 420; Kenneth Hugh Connell, *The Population of Ireland, 1750-1845*, Oxford, 1950, p. 53; E. F. Heckscher, *op. cit.*, p. 163; Gustaf Utterström, *loc. cit.*, pp. 154, 158; H. J. Habakkuk, " Family Structure and Economic Change in Neneteenth Century," *The Journal of Economic History*, 1955, 15, pp. 5, 6.

ciated with the degree of difficulty of obtaining new land *not far from the place of residence,* it is desirable to compute an index of the availability of land for small units such as counties, or even towns and villages. However, this computation would involve a tremendous amount of work which is not practicable in this study. Therefore, we decided to use the state as our geographical unit, even though an index of the availability of land for an area as large and variable in size as the state is bound to be crude.

The proportion of improved land in the total farm land in a state or territory, reported in the census of 1850, may be considered a measure of the availability of land in a state or territory, if it is true that all or most of the land which could be converted into improved farm land in the near future was already owned by somebody and reported as farm land.[31]

A glance at Table V-8 reveals that there was a wide variation in the proportion of improved land in the total farm land of a state or territory in 1850. The proportion of improved land was largest in New England, in the Middle Atlantic Division and in the northern part of the South Atlantic Division, and smallest in the agricultural states and territories in the Deep South and in the frontier areas.

There is an inverse association between the proportion of improved land in total farm land and the white refined birth ratio in a state or territory. Kendall's τ for all states and territories is —.509, and for states alone —.614. Both are significant at the 1% level of probability. τ for free states and territories is —.564 and significant at the 1% level but τ for slave states and territories is only —.295 and not significant even at the 5% level. The low coefficient in slave states is caused primarily by the "undeservedly" high ranking, in land-use, of the states in the newer cotton area like Alabama, Mississippi, and Arkansas and the low ranking of older states like North and South Carolina. The higher degree of land-use in the former may be the result of rapid settlement during the preceding decade or two.

[31] According to the instructions to marshals, "improved land" is "cleared land used for grazing, grass, or tillage, or which is not fallow, connected with or belonging to the farm," and "unimproved land" includes "a wood lot, or other land at some distance, but owned in connection with the farm, the timber or range of which is used for farm purposes." U. S. Census Office, *The Seventh Census of the United States: 1850,* p. xxiii.

Probably a better measure of the availability of land is population density expressed in the form of the number of persons per acre of arable land or land suitable for cultivation. Theoretically the amount of arable land in a state or territory has changed from time to time, as agricultural techniques and trans-

TABLE V-8

PROPORTION OF IMPROVED LAND IN TOTAL FARM LAND, BY STATE OR TERRITORY: UNITED STATES, 1850

New England	
Maine	44.8%
New Hampshire	66.4
Vermont	63.1
Massachusetts	63.6
Rhode Island	64.4
Connecticut	74.2
Middle Atlantic	
New York	64.9
New Jersey	69.2
Pennsylvania	57.8
South Atlantic	
Delaware	60.8
Maryland	60.4
Virginia	39.6
North Carolina	26.0
South Carolina	25.1
Georgia	28.0
Florida	21.9
East North Central	
Ohio	54.7
Indiana	39.5
Illinois	41.9
Michigan	44.0%
Wisconsin	35.1
East South Central	
Kentucky	35.2
Tennessee	27.3
Alabama	36.6
Mississippi	32.8
West North Central	
Minnesota	17.5
Iowa	30.1
Missouri	30.2
West South Central	
Arkansas	30.1
Louisiana	31.9
Texas	5.6
Mountain	
New Mexico	57.2
Utah	34.9
Pacific	
Oregon	30.7
California	.8

Source: U. S. Census Office, *The Seventh Census of the United States: 1850*, Washington 1853, p. lxxxii.

portation facilities have been developed and as population has been redistributed. However, such changes have not been quantified into statistics, and a static measure of the amount of arable land has to be used. Following Professor Kuznets [32] we decided to use the acreage of cropland as of 1949.

[32] Simon Kuznets, Ann Ratner Miller, and Richard A. Easterlin, *Population Redistribution and Economic Growth, United States, 1870-1950*, Vol. II, *Analysis of Economic Change*, Philadelphia 1960, p. 215.

Another problem which confronts the analysis of population density and fertility is the association between population density and urbanization. It may be argued that the population density of a state reflects its degree of urbanization rather than its degree of land-use and, therefore, by analyzing the relationship between population density and fertility, we are simply repeating what we have done in the first section of this chapter. This criticism would be fully justified if the amount of land a person used for agricultural purposes were the same everywhere, and if all arable land had already been put under cultivation. It is quite obvious that the United States before the Civil War had not reached the stage in which the second condition was satisfied. Yet the problem still remains: for (1) urban residents, a part of whom would not have been interested in becoming farmers anyway, enter into population density, though they were rather small in number, and (2) embryonic industrialization-urbanization may have tended to take place in states where land was more fully utilized and, hence, where a larger supply of potential labor existed.

Indeed, there was a positive correlation between population density and the proportion of urban population in a state as early as 1800, τ being .348 and significant at the 5% level.[38] However, this tends to encourage, rather than discourage, our going ahead with the analysis of population density and fertility. For in view of the very small proportion of urban population in most states and territories at that time, it is not at all impossible that what looked like a causal relationship between urbanization and fertility was actually the causal relationship between the availability of land and fertility. Whether this was the case or not, τ for population density and urbanization which is much lower than unity suggests that an analysis of the relationship between population density and fertility may be much more than an indirect analysis of the relationship between urbanization and fertility.

As time passed, the proportion of urban population in some of the older states became quite large, and population density became chiefly an index of urbanization. An increase in the value of the coefficient of rank correlation between population

[38] Territories and the state of Georgia are not included due to the fact that population density cannot be computed because of changes in boundaries.

density and the proportion of urban population indicates a change in this direction. Yet, τ in 1860 even for the oldest sixteen states, same area as in 1800, was far short of unity, being .617 and τ for all states and territories was only .373.

Table V-9 shows the population density, or the number of

TABLE V-9

NUMBER OF PERSONS PER 1,000 ACRES OF ARABLE LAND[a], BY STATE OR TERRITORY: UNITED STATES, 1800-1860

State or territory	1800	1810	1820	1830	1840	1850	1860
New England							
Maine	128	193	252	337	423	492	530
New Hampshire	527	614	700	772	815	911	934
Vermont	165	232	252	299	312	335	336
Massachusetts	895	998	1106	1290	1560	2102	2602
Rhode Island	1257	1400	1510	1767	1979	2682	3175
Connecticut	680	710	746	807	840	1005	1247
Middle Atlantic							
New York	85	139	199	278	352	449	562
New Jersey	228	264	298	345	401	526	722
Pennsylvania	88	119	154	197	252	338	425
South Atlantic							
Delaware	139	157	157	166	169	198	242
Maryland	186	207	222	243	256	317	374
Virginia	152	168	184	209	214	245	276
North Carolina	69	80	92	106	108	125	143
South Carolina	71	85	103	119	121	137	144
Georgia		27	37	56	75	98	115
Florida				15	23	37	59
East North Central							
Ohio		20	51	83	134	175	207
Indiana		2	13	29	58	84	115
Illinois			3	7	22	39	80
Michigan					23	44	83
Wisconsin						28	72
East South Central							
Kentucky	35	64	89	109	123	155	182
Tennessee	15	37	60	97	117	142	157
Alabama			18	43	83	108	135
Mississippi			10	19	51	82	107
West North Central							
Minnesota							8
Iowa						8	29
Missouri					28	50	87
Kansas							4

State or territory	1800	1810	1820	1830	1840	1850	1860
West South Central							
Arkansas				4	14	29	33
Louisiana			35	56	91	134	184
Texas						7	19
Mountain							
Colorado							3
Pacific							
Oregon							11
California						9	37

Note: *a.* Arable land is defined as cropland in 1949, which included "cropland harvested, crop failure, and cropland fallow or idle, and in cover or soil-improvement crops in 1949." Because the acreage of cropland is given by state as of 1949, population density could be computed only for those states and territories whose boundaries were approximately the same as in 1949, except Virginia, for which the total acreage of cropland in Virginia and West Virginia in 1949 could be used as the denominator.

Source: H. H. Wooten, *Basic Land Use Statistics, 1950: Supplement to Major Uses of Land in the United States*, Washington 1953, pp. 9-11; and U. S. Censuses, cf. Appendix III.

persons per acre of cropland in 1949, of a state or territory from 1800 to 1860. Despite the expansion of the country and the movement of population from thickly populated to sparsely populated areas, the population density of every state and territory increased from one census year to another. In 1800 the center of the high density area was in the lower New England states from where, as distance increased, density became lower in a concentric fashion. The inland states of Kentucky and Tennessee, states in the southern part of the South Atlantic Division, were among the most sparsely populated. The low densities of Pennsylvania and New York seem to be misleading as indicators of the availability of land to an average resident in these states, for much of the land beyond the Appalachian Mountains was not easy of access at this time.

As time passed, the basic geographical pattern of population density changed little. In 1860 the southern New England states still ranked at the top, followed by other states in the northern Atlantic area. As in 1800, territories and new states were among the most sparsely populated.

The geographical pattern of population density seems to have

been inversely similar to that of the refined birth ratio of the white population. The coefficients of rank correlation, τ, verify this impression (Table V-10). Throughout the period, 1800-1860, they are negative, ranging from —.526 to —.848, and significant at the 1% level of probability. The absolute value of the coefficient for free states and territories is larger than that for the whole United States in every year and also higher than

TABLE V-10

KENDALL'S COEFFICIENT OF RANK CORRELATION (τ) BETWEEN THE NUMBER OF PERSONS PER 1,000 ACRES OF ARABLE LAND[a] AND THE WHITE REFINED BIRTH RATIO[b] IN A STATE OR TERRITORY: UNITED STATES, 1800-1860

	1800	1810	1820	1830	1840	1850	1860
For all states & territories[c]	-.633**	-.848**	-.802**	-.773**	-.675**	-.604**	-.526**
For free states & territories[c]	-.667*	-.927**	-.848**	-.879**	-.795**	-.633**	-.555**
For slave states & territories[c]	-.571	-.714*	-.673**	-.641**	-.560**	-.619**	-.583**

Note: * Significant at the 5% level. ** Significant at the 1% level. *a.* Arable land is defined as cropland in 1949. Cf. Table V-9. *b.* The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44. *c.* Only those states and territories which had approximately the same area in the year mentioned as in 1949.

that for slave states and territories in every year except 1860. The weaker association in the South is what is expected from the existence of the colored population in the area.

There is a clear trend in the coefficient. Except for an increase from 1800 to 1810, the absolute value of the coefficient decreased every decade. This is in striking contrast to the case of the coefficient of rank correlation between the proportion of urban population and fertility in which there was either no trend or an insignificant one upward. The coefficients between population density and fertility were much higher than those between urbanization and fertility during the first few decades of the nineteenth century. The difference became smaller later and the values of

the two coefficients were about the same toward the end of the period under consideration.[34]

Turning to the analysis of the association between the increase in population density and the decrease in the refined birth ratio in the period 1800-1860, we find that, when states and territories are standardized with respect to the initial level of fertility, the coefficient of standardized rank correlation, τ_s, between the absolute changes in both original variables is .476 and the coefficient between the absolute decline in fertility and the relative increase in population density is .357.[35]

The period 1800-1860 was then divided into two thirty-year sub-periods and the coefficients of standardized rank correlation between the changes in both variables were computed for each sub-period. As is seen in Table V-11, the coefficients are all positive, ranging between .095 and .857. The values of the coefficients are larger when a time lag is allowed between the change in population density and the change in the refined birth ratio than when no time lag is allowed. There is a downward trend in the degree of association between the increase in population density and the decline in the refined birth ratio. The coefficients are much higher in the first sub-period than in the second except in one case. i.e., in the correlation between the absolute decline in the refined birth ratio and the relative increase in population density without a time lag, where the coefficients are about the same in each of the sub-periods.[36]

Though the trend is downward, it must be pointed out that

[34] Strictly speaking, the coefficients in Table V-4 are not comparable with the present coefficients because some of the states and territories represented in the former are not included in the latter. The coefficients of rank correlation between the white refined birth ratio and the proportion of urban population for the areas repersented in the present coefficients are –.436, –.472, –.520, –.455, –.561, –.614, and –.528 for successive census years between 1800 and 1860.

[35] When observations are not standardized, the coefficients of rank corerlation, τ, between the absolute changes in the wo original variables between 1800 and 1860 is –.050, while the coefficient for the relative changes in the two original variables is .233. Neither is statistically significant. The confusion seems to result from the methodological defect in the conventional analysis discussed in pp. 146-149.

[36] If we compute, following the conventional method, Kendall's τ between the increase in population density and the decrease in the refined birth ratio, the results are rather confusing. Some of the coefficients are negative; moreover, when the relative decline in the refined birth ratio is matched with the absolute or relative increase in population density, the values of the coefficients are larger for the period 1830-1860 than for the period 1800-1830, whereas the opposite holds when the absolute decline in the refined birth ratio is matched with the increase in population density.

TABLE V-11

COEFFICIENT OF RANK CORRELATION (τ_s) BETWEEN THE INCREASE IN THE NUMBER OF PERSONS PER 1,000 ACRES OF ARABLE LAND[a] AND THE DECLINE IN THE WHITE REFINED BIRTH RATIO[b] IN A STATE OR TERRITORY WITH STATES AND TERRITORIES STANDARDIZED WITH RESPECT TO THE INITIAL LEVEL OF THE WHITE REFINED BIRTH RATIO: UNITED STATES,[c] 1790-1860

A. Without a time lag.

(i) *Changes in both variables between 1800 and 1830.*

	Population density	
	Absolute increase	Relative increase
Absolute decline[d] in the refined birth ratio	.762 (16)	.095 (16)

(ii) *Changes in both variables between 1830 and 1860.*

	Population density	
	Absolute increase	Relative increase
Absolute decline[d] in the refined birth ratio	.311 (25)	.111 (25)

B. With a time lag.

(i) *Decline in the refined birth ratio between 1800 and 1830 and increase in population density between 1790 and 1820.*

	Population density	
	Absolute increase	Relative increase
Absolute decline[d] in the refined birth ratio	.857 (16)	.476 (16)

(ii) *Decline in the refined birth ratio between 1830 and 1860 and increase in population density between 1820 and 1850.*

	Population density	
	Absolute increase	Relative increase
Absolute decline[d] in the refined birth ratio	.390 (23)	.302 (23)

Note: Figures in parentheses show the numbers of states and territories represented. If the number of states and territories is between $10(n-1)$ and $10n$, n being an integer, states and territories $(n+1)$ positions or less apart in ranking with respect to the standardized variable are matched. *a.* Arable land is defined as cropland in 1949. Cf. Table V-9. *b.* The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44. *c.* Only those states and territories which had aproximately the same area in the year mentioned as in 1949. *d.* The coefficient of correlation betweenn relative decline in the refined birth ratio and changes in population density were not computed, because it was expected that ranks of a state with respect to absolute and relative declines in the refined birth ratio would be more or less the same *within a stratum.*

the values of the coefficients of standardized correlation for the change in population density and the change in fertility are somewhat larger than those for the change in the proportion of urban population and the change in fertility even in the later sub-period. While the former coefficients in this period are .311, .111, 390, and .302 for different combinations of changes and time patterns, the comparable figures of the latter coefficients are .178, .255, .233, and .286.

To see what happened in the period after 1860, data on population density in 1900 were analyzed in relation to fertility. Population density in a state or territory was still significantly correlated with fertility but the coefficient of rank correlation (—.421) was much lower than the comparable coefficient for the period before 1860 and also lower than the coefficient for the degree of urbanization and fertility (—.638) or for the degree of industrialization and fertility (—.617) in 1900.

For the period 1860-1900, with observations standardized with respect to the original level of the refined birth ratio, the coefficient of standardized rank correlation, τ_s, between the absolute increase in population density and the absolute decrease in the refined birth ratio is .241 and τ_s between the relative increase in population density and the absolute decrease in the refined birth ratio is .366.[37] The values of the coefficients are smaller than those for the period 1800-1830 and are comparable with those for 1830-1860.

The evidence examined is again scarce and the measures of land-availability are crude. Besides the points already discussed we must admit that such relevant factors as the land-laws, the distribution of land-ownership, and the use to which the land was put, are not reflected in the measures of land-availability used in this section. Nevertheless, the analysis has yielded a rather illuminating result and the following may be said in summing it up.

In view of the very close association between population density and fertility, the extent of land-use within the settled areas, or the availability of easily accessible land nearby, may have been an important determinant of the level of fertility throughout the period, 1800-1860, particularly in the early part of it. A close association between the change in population density and the

[37] The number of states represented is 32.

change in the refined birth ratio during the first half of the period also supports this hypothesis. Later, the association between population density and the birth ratio as well as the association between the change in population density and the change in the refined birth ratio became weaker, despite the fact that the correlation between population density and urbanization and the correlation between the change in the degree of urbanization and the change in the refined birth ratio both became closer. Apparently, the extent of land-use became less important as a determinant of fertility.

3. *Income and Wealth*

That the level of living of a family, or any other population group, is inversely correlated with its fertility is, like the correlation between industrialization-urbanization and fertility, one of the better established theses in demography.[38] A part of the correlation is likely to be explained by other factors, such as rationality and intelligence, which affect both fertility and income. Again, the relative level of income of a family in a society, quite apart from the absolute level of income, may affect its fertility To the extent that these are true, the inverse correlation between income or wealth and fertility is of little, if any, help in explaining the trend in fertility.

Many writers, however, have gone further and suggested that the absolute level of income has affected fertility.[39] According to this thesis, when the absolute level of income of a family, or of any population group, increases, its standard, or hoped-for level, of living tends to increase more rapidly than its actual level of living with the result that it tries to close the gap by reducing the number of children. The standard of living is undoubtedly influenced by many other factors, some of which have been mentioned in connection with urbanization, but it seems reasonable to assume that many of the goods and services which come within reach of the public as a result of an increase

[38] This thesis apparently does not apply to the United States in the 1950's. Cf. Grabill et al., *op. cit.*, pp. 275-277.

[39] United Nations, Department of Social Affairs, Population Division, *The Determinants and Consequences of Population Trends*, Population Studies No. 17, New York 1953, p. 80; Jaffe, *loc. cit.*, p. 59; Harrod, *loc. cit.*, p. 13; Ross, *loc. cit.*, p. 81.

in income have very high, possibly greater than unity, income elasticity of demand.

A. J. Jaffe pointed out several instances of inverse correlations between economic status and fertility in the United States before the Civil War.[40] For example, in New York City in 1820, wards with higher proportions of white males 21 years of age or older owning property worth more than $250 tended to show lower ratios of white children to white women. When the wards were divided into three groups according to their proportion of such property owners, the average fertility of the richest ward group was 80% and that of the intermediate group 82% of the average fertility of the poorest group. A similar inverse association was also reported by Jaffe for the urban areas of Boston (1830) and Providence (1830) and for the rural counties of New York (1821), South Carolina (1800), North Carolina (1800 and 1820), and Georgia (1820). In the southern states the number of slaves owned was used as a criterion of economic status.

In all these examples economic status was measured by wealth rather than by income. Income data in the ninteenth century are very scarce and undependable [41] but for the year 1840 it is possible to analyse the relationship between income per person 10 years of age or older [42] and fertility in a state or territory thanks

[40] A. J. Jaffe, "Differential Fertility in the White Population in Early America," *The Journal of Heredity*, September 1940, 31, pp. 408-410.

[41] It may seem that the relationship between change in per capita national income and change in fertility over time can profitably be analysed, using the national income series constructed by Martin. (Robert F. Martin, *National Income in the United States: 1799-1938,* New York 1939.) However, the value of such an analysis is very doubtful for the following reasons. (1) Different schedules were used in different censuses in collecting data. Therefore, the scope of the coverage may have been different in different censuses. (2) No inquiry was made in some censuses, e. g., 1800 and 1830. The values and/or quantities for these census years were either extrapolated or interpolated. For the output in industries other than agriculture and manufacturing extrapolation and interpolation had to be used very extensively. (3) Even for agriculture and manufacturing we have data only for one out of ten or twenty years. In view of probable fluctuations in output, the true trend in per capita output in the period before 1860 may have been considerably different from the trend shown in the Martin series. (4) The proportion of the unaccountable income to the accountable may have changed over time. (5) On the side of fertility, the relatively low birth ratio in 1850 may be misleading. Cf. Professor Kuznets' discussion of the matter in *Income and Wealth of the United States: Trends and Structure*, ed. by Simon Kuznets, *Income and Wealth*, Series II, Baltimore 1952. pp. 221-239.

[42] Since the proportion of persons aged 10-14 in total population may have been correlated with the proportion of persons under 10 years of age in total population,

to the estimate of state or territorial income made by Donald S. Murray, based on the contemporary estimates by George Tucker and Ezra C. Seaman.

TABLE V-12

AVERAGE INCOME[a] PER PERSON 10 YEARS OF AGE OR OLDER BY STATE OR TERRITORY: UNITED STATES, 1840

New England		*East North Central*	
Maine	$ 79	Ohio	$ 69
New Hampshire	79	Indiana	57
Vermont	79	Illinois	63
Massachusetts	139	Michigan	59
Rhode Island	153	Wisconsin	103
Connecticut	115	*East South Central*	
Middle Atlantic		Kentucky	69
New York	104	Tennessee	60
New Jersey	116	Alabama	75
Pennsylvania	101	Mississippi	114
South Atlantic		*West North Central*	
Delaware	101	Iowa	53
Maryland	87	Missouri	74
Virginia	75	*West South Central*	
North Carolina	67	Arkansas	87
South Carolina	75	Louisiana	157
Georgia	80		
Florida	85	U. S.	97

Note: *a*. Income includes that from agriculture, manufacturing, commerce, mining, and fisheries and excludes that from service industries, government and finance.

Source: Donald S. Murray, *Changes in the Distribution of Income by States, 1840-1938*, unpublished Ph. D. dissertation, University of Pennsylvania, 1944, pp. 29-30.

As is seen in Table V-12, the geographic pattern of average income per person 10 years of age or older seems to resemble that of the proportion of urban population, or that of the proportion of those employed in non-agricultural pursuits, or even that of population density, and to be opposite to that of white fertility. Ranking states and territories in the order of white refined birth ratio and also in the order of average income, we

it would be more desirable to compute income per person 15 years of age or older, but the colored population was not classified into detailed enough age-classes to make such computation practicable.

computed Kendall's coefficient of rank correlation. It turned out to be —.333 and significant at the 5% level of probability. The coefficient for states only is —.350 and is also significant at the 1% level. When states and territories are divided into slave and non-slave, it is revealed that a relatively low coefficient for all states and territories (coefficients of correlation between fertility, on one hand, and the degree of industrialization, the degree of urbanization, and population density, on the other, are all much higher), is a composite of a rather high (—.657) coefficient for non-slave states and territories and a low (—.033) coefficient for slave areas. The former is significant at the 1% level, while the latter is not significant statistically. The very low coefficient for the South, as we shall see later, may be due to the predominantly agricultural character of this region.

Aside from the fact that income rather than wealth was used as an index of the level of living, our analysis is different from Jaffe's in two points. First, in our analysis the geographical unit was as large an area as the state or territory, while in Jaffe's the ward or county was the unit. Secondly, our observations were not standardized with respect to rurality while Jaffe's were to some extent.

As to the first point, our method may be said to have an advantage if we are interested in the explanation of the trend in fertility. For when we use small units such as wards or families, what we are testing may not be the hypothesis that, when income increases, ambition increases still more rapidly and, hence, fertility decreases, but one or both of two other hypotheses, namely (1) that the *relative* economic standings of families or individuals in a society affect their fertility, and (2) that other factors, such as the intelligence of families or individuals, affect both their relative levels of income and their fertility. When as large a unit as the state or territory is used, this difficulty is largely removed.

On the second point, however, our method is inferior because what seems to be a causal relationship between per capita income and fertility may simply reflect two other causal relationships, that is, between industrialization and per capita income and between industrialization and fertility. This leads us to the next section where an effort is made to standardize observations with respect to one of the socio-economic variables.

4. *Interaction of Industrialization-Urbanization, the Availability of Easily Accessible Land and Income*

So far we have seen that all three socio-economic variables, industrialization-urbanization, population density, and average income per person 10 years of age or older can explain, in the statistical sense, the differences in state (or territorial) fertility and, in some cases, the differential changes in state fertility. The trouble is that these three socio-economic variables are correlated with each other, and therefore, what appears to be the causal relation between one of them and fertility may actually represent the causal relationship between another of them and fertility. Even the trend in the coefficient of correlation for one socio-economic variable and fertility may be misleading when the degree of association between this socio-economic variable and another which is correlated with fertility changes over time.

In order to remove part of this difficulty the method of moving standardization was used. Fertility and one socio-economic variable of states similar with respect to another socio-economic variable were compared, and the coefficient of rank correlation was computed.[43] Since the states which were matched were not exactly similar with respect to the second socio-economic variable, the value of a τ_s is less meaningful than the value of a parametric coefficient of partial correlation. However, it seems to be justifiable to claim that τ_s is a better indicator of the net relationship between the two variables matched than τ is.

The result of the computation is summarized in Table V-13. Most interesting is the contrast between the coefficient for fertility and the degree of urbanization with population density standardized, on one hand, and the coefficient for fertility and population density with the degree of urbanization standardized, on the other. In the former, with some exceptions, the trend (in the absolute value) is mildly upward while in the latter the trend is decidedly downward. At the beginning of the nineteenth century, the absolute values of τ_s for population density and fertility are more than twice, in some years more than three times,

[43] The degree of industrialization-urbanization was represented by the proportion of urban population and no use was made of the proportion of those who were employed in non-agricultural pursuits, because it was felt that these two variables were indices of the same socio-economic complex.

TABLE V-13

COEFFICIENT OF RANK CORRELATION (r_s) BETWEEN THE WHITE REFINED BIRTH RATIO[a] AND ONE OF THE SOCIO-ECONOMIC VARIABLES IN A STATE OR TERRITORY[b], WITH STATES AND TERRITORIES STANDARDIZED WITH RESPECT TO ANOTHER SOCIO-ECONOMIC VARIABLE: UNITED STATES, 1800-1860 AND 1900.

A. States and territories are standardized with respect to population density, or number of persons per 1000 acres of arable land.[c]

Correlation between the refined birth ratio and;	The proportion of urban population	Average income per person 10 years of age or older
1800	—.333 (16)	
1810	—.250 (19)	
1820	—.343 (23)	
1830	—.214 (25)	
1840	—.389 (27)	—.163 (27)
1850	—.391 (31)	
1860	—.346 (35)	
1900	—.473 (47)	

B. States and territories are standardized with respect to the proportion of urban population.

Correlation between the refined birth ratio and;	Population density	Average income per person 10 years of age or older
1800	—.825 (16)	
1810	—.806 (19)	
1820	—.787 (23)	
1830	—.705 (25)	
1840	—.371 (27)	+.067 (27)
1850	—.510 (31)	
1860	—.419 (35)	
1900	—.391 (47)	

C. States and territories are standardized with respect to average income.

Correlation between the refined birth ratio and;	Population density	The proportion of urban population
1840	—.592 (27)	—.521 (27)

Note: Figures in parentheses show the number of states and territories represented. If the number of states and territories is between $10(n-1)$ and $10n$, n being an integer, states and territories $(n+1)$ positions or less apart in ranking with respect to the standardized variable are matched. *a.* The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44. *b.* Only those states and territories whose acreage of arable land is known are represented. *c.* Arable land is defined as cropland in 1949. Cf. Table V-9.

as large as those for the degree of urbanization and fertility. The gap narrows in later years but the former remains larger than the latter throughout the period under consideration, 1800-1860, except in 1840 when the relationship is temporarily reversed. The gap is probably closed some time between 1860 and 1900, for in the latter year, the absolute value of the coefficient for urbanization and fertility exceeds that for population density and fertility.

In most census years the absolute values of the coefficients of rank correlation between population density and fertility are slightly larger when not standardized than when standardized with respect to the proportion of urban population. However, the absolute values of the coefficients of rank correlation between the proportion of urban population and fertility are much larger in most years when not standardized with respect to population density.

Thus, it appears that population density, which, with states and territories standardized with respect to the degree of urbanization, presumably represents the availability of easily accessible land, was much more important than industrialization-urbanization as a factor affecting fertility during the first few decades of the nineteeenth century. The importance of the former diminished with time, while that of the latter increased. Yet it was not until after the Civil War, it seems to us, that the relative importance of the two factors was reversed.

When states and territories are standardized with respect to average income per person 10 years of age or older, the absolute values of the coefficients of rank correlation between fertility and population density and also between fertility and the degree of urbanization in 1840 become a little smaller than when unstandardized. However, the coefficient of rank correlation between fertility and average income in 1840 is almost reduced to nil, when observations are standardized with respect to the degree of urbanization. Apparently, a significant inverse correlation between fertility and average income, which was observed in the preceding section of this chapter, was the product of two correlations, one between industrialization-urbanization and fertility and the other between industrialization-urbanization and average income.

A closer look at the interaction of the three variables, fertil-

TABLE V-14

ANALYSIS OF THE ASSOCIATION BETWEEN THE WHITE REFINED BIRTH RATIO[a] AND AVERAGE INCOME PER PERSON 10 YEARS OF AGE OR OLDER IN A STATE OR TERRITORY, WITH STATES AND TERRITORIES STANDARDIZED WITH RESPECT TO THE PROPORTION OF URBAN POPULATION: UNITED STATES, 1840.

State or territory in the order of the proportion of urban population		Rank of a state or territory with respect to the white refined birth ratio	Rank of a state or territory with respect to average income per person 10 years of age or older	
1	Rhode Island	26	2	ooxx
2	Massachusetts	27	3	oxxx
3	Louisiana	14	1	oooo
4	Maryland	21	11	xoxo
5	New York	23	7	xxxo
6	Pennsylvania	17	9	xxxo
7	Connecticut	25	5	xoxx
8	Delaware	20	8	ooxxx
9	New Jersey	19	4	oxxx
10	New Hampshire	24	14	xxxx
11	Maine	18	16	xxxx
12.5	South Carolina	12	17	oxoxx
12.5	Virginia	15	19	xoxx
14	Ohio	10	21	ooxo
15.5	Michigan	16	26	xxxxx
15.5	Missouri	5	20	oooox
17	Kentucky	7	22	oooo
18	Georgia	4	13	oooo
19	Alabama	2	18	ooox
20	Illinois	8	24	xoox
21	North Carolina	13	23	xoxxoo
22	Indiana	9	27	ooxxo
23	Mississippi	3	6	ooox
24	Tennessee	6	25	xxo
26	Vermont	22	15	oo
26	Florida	11	12	o
26	Arkansas	1	10	

Note: *a.* The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44.

ity, urbanization and average income, reveals an interesting fact. As is seen in Table V-14 "wrong" matches (x's), that is, those in which the order of rankings with respect to fertility is different from the order of rankings with respect to average income, are concentrated in urban states and "right" matches (o's) are

mostly found in rural areas. When states and territories are divided into two groups according to the degree of urbanization, τ_s for 14 urban states (standardized with respect to the degree of urbanization) is seen to be —.319 and τ_s for 13 rural states and territories .391. Thus, it appears that the level of average income as such exerted opposite effects in rural and urban areas. Greater income is associated with higher fertility in the former and lower fertility in the latter. This result, though not by any means conclusive because of the small number of observations in the sample, is not against common sense. For in rural areas in the first half of the nineteenth century people were much less exposed to luxuries and other refined goods and services than in cities and, when income became larger, they may have spent more in setting up their children as independent farmers or in having more children.[44]

We have seen in the preceding section of the chapter that Kendall's coefficient of rank correlation between fertility and average income per person 10 years of age or older in a slave state or territory in 1840 is very low (—.033). This appears now to be the result of (1) a positive association between income per person 10 years of age or older and fertility in rural areas and (2) the fact that slave areas were predominantly agricultural. (The proportion of urban population in all but five of the slave states and territories was lower than the national median and in two of those five it was only slightly above the median.)

5. *Immigration*

A theory advocated by Francis A. Walker explains the fall in the fertility of native women, and consequently, of the total female population by the influx of foreign immigrants. According-

[44] Since it is known that per capita income was correlated with the degree of urbanization, it may seem that an inverse correlation in urban states and a positive correlation in rural states and territories between income and fertility may represent another hypothesis that the association between income and fertility was positive at low income levels and negative at high income levels. However, the alternative hypothesis does not seem to be tenable, for when states and territories are classified into two groups according to their income level and standardized with respect to their degree of urbanization, τ_s between income and fertility is .027 for the higher income group and .143 for the lower.

ing to Walker, native Americans were unwilling "to engage in the lowest kind of day-labor with these new elements of the population" and limited the size of their families. The sight of the wretched lives of these immigrants, "houses that were mere shells for human habitations, the gate unhung, the shutters flapping or falling, green pools in the yard, babes and young children rolling about half naked or worse, neglected, dirty, unkempt," gave native Americans an additional and sentimental reason not to bring sons and daughters into this world.[45]

The theory was claimed to be supported by statistical evidence both historically and geographically. Historically, it was asserted, the native population, which had increased vigorously since colonial days, started to withhold its increase, as foreigners began to arrive in large numbers in the 1830's. As the flow of immigration swelled in the ensuing decades, native Americans reduced the number of their offspring still more. As a result, "foreign immigration into this country has, from the time it first assumed large proportions, amounted, not to a reenforcement of our population, but to a replacement of native by foreign stock." [46]

Geographically, claimed Walker, "the decline in the native element . . . occurred chiefly in just those regions to which the newcomers most freely resorted." [47] Later, Weld A. Rollins offered statistical evidence to support this view. He compiled from census monographs a table showing for each census division the fertility of native whites in the decade 1910-1920, and the proportion of white immigrants and their children in the total white population in 1920. (Table V-15) Apparently, the inverse association between immigration and native fertility is perfect.

Of course, the decline of fertility is not restriced to immigrant countries. All the countries in the European cultural sphere which have gone through industrializtion have experienced a fall

[45] Francis A. Walker, "Immigration and Degradation," in *Discussions in Economics and Statistics*, ed. by Davis R. Dewey, Vol. II, New York 1899, p. 424. The theory, without its anti-immigrant tone, was anticipated by Benjamin Franklin more than a century before. He wrote, "The importation of foreigners into a country, that has as many inhabitants as the present employments and provisions for subsistence will bear, will be in the end no increase of people, unless the new comers have more industry and frugality than the native, and then they will provide more subsistence, and increase in the country; but they will gradually eat the natives out." Jared Sparks, ed., *The Works of Benjamin Franklin*, Vol. II, Boston 1836, p. 318.

[46] Walker, *loc .cit.*, p. 425.

[47] *Ibid.*, p. 423.

in fertility whether they were net senders or receivers of international migrants. Even if we restrict our attention to the United States, it is apparent that, as far as the twentieth century is concerned, the movement of the birth rate had little to do with the tide of immigration. In the face of these facts the Walker theory may seem rather absurd. However, since Walker presented his theory chiefly to account for demographic changes in the nineteenth century and since he asserted that the alternative explanation in terms of the increase in luxuries was not tenable in the early period, it should be worthwhile to inquire what additional statistical evidence we have either to support or discredit his thesis.

TABLE V-15

FERTILITY OF NATIVE WHITES, 1910-1920, AND THE PROPORTION OF WHITE IMMIGRANTS AND THEIR CHILDREN IN THE TOTAL WHITE POPULATION IN 1920, BY DIVISION: UNITED STATES

Division	Fertility of native whites[a]	Proportion of white immigrants and their children
New England	13.6%	61.0%
Middle Atlantic	15.5	54.0
Pacific	17.2	44.3
East North Central	18.8	42.6
West North Central	20.7	37.9
Mountain	24.1	36.3
West South Central	26.3	11.3
South Atlantic	26.3	6.2
East South Central	26.7	3.1

Note: *a*. Fertility rate for each division was obtained "by dividing the number of native white children under 10 years of age, excluding those of foreign parentage and one-half those of mixed parentage, enumerated in a given division . . . by the average number of native white persons in the same division . . . during the decade (that is, a simple average of the numbers enumerated at the beginning and end of the decade)." (William S. Rossiter, *Increase of Population in the United States: 1910-1920*, Census Monograph I, Washington 1922, p. 205.)

Source: Rollins, *loc. cit.*, p. 396; Rossiter, *op. cit.*, p. 169.

First, it must be pointed out that the decline in fertility started much earlier than the increase of immigration. It was established in earlier chapters that the fall in fertility began at latest at the beginning of the nineteenth century, and probably earlier.

The relationship between immigration and native fertility is untestable for the period before 1860, because population was not classified before 1870 by the nativity of parents. All we can do is to analyze the association between immigration and fertility in general. During the four decades after 1820 for which official statistics of the number of foreign steerage passengers arriving at American ports are available, both the absolute and

TABLE V-16

ABSOLUTE AND RELATIVE NUMBERS OF FOREIGN STEERAGE PASSENGERS ARRIVING AT AMERICAN PORTS AND THE CHANGE IN THE WHITE REFINED BIRTH RATIO[a] IN THE UNITED STATES IN EACH DECADE: 1820-1860

Decade (1)	Number of passengers (1,000) (2)	White population in the United States at the end of each decade (1,000) (3)	Ratio of passengers to the white population $\frac{(2)}{(3)}$ (4)	Absolute fall in the refined birth ratio (per 1,000) (5)	Relative fall in the refined birth ratio (6)
1820–30	129	10,537	1.2%	149	7.6%
1830–40	552	14,190	3.9	72	4.5
1840–50	1,558	19,553	8.0	179	11.8
1850–60	2,708	26,957	10.0	27	2.0

Note: *a*. The refined birth ratio is the number of children under 10 years of age per 1,000 women aged 16-44.

Source: White population, U. S. Censuses. Cf. Appendix III; foreign passengers, U. S. Census Office, *Population of the United States in 1860*, Washington 1864, p. xix; refined birth ratio, Table I-4.

the relative—relative to white population in the United States —numbers of foreign passengers increased from one decade to another. (See Table V-16.) Yet, there is no indication that the fall in white fertility was accelerated over time. It is true that the refined birth ratio declined very rapidly between the decade 1830 - 1840 and the next decade, when immigration increased greatly, but, as we have pointed out before, a part of the large decline in the refined birth ratio may be attributed to a larger-than-usual underenumeration of children in 1850. Anyway, the decline in the birth ratio was rather small in the following ten years when a still larger number of immigrants arrived.

The census of 1820 recorded the number of foreigners not naturalized and the census of 1850 and later censuses the number of the foreign born. From these records the proportion of foreigners in 1820 and the proportion of the foreign born in 1860 in total white population was computed by state (Table V-17). The geographical pattern of the proportion of foreigners or the foreign born, unlike those of other socio-economic variables, can not be described in a simple way. Generally speaking, the proportions of foreigners or the foreign born in the Middle Atlantic, southern New England, and Midwestern states were among the highest and those in the states in the Lower South among the lowest but there were many exceptions.

Kendall's coefficient of rank correlation (τ) between the proportion of foreigners unnaturalized and the white refined birth ratio in a state or territory in 1820 is —.022 and not significant at the 5% level. Exclusion of territories helps little, the coefficient for states only being —.036 and not significant either. When states and territories are divided into slave and non-slave, the coefficient improves considerably (for slave states and territories it is —.307 and for non-slave states and territories —.390) but it is still short of being significant at the 5% level.

Kendall's coefficient of rank correlation between the proportion of the foreign born and the white refined birth ratio in a state or territory in 1860 is —.163 and not significant statistically. When territories are excluded, it improves considerably to —.227 and becomes significant at the 5% level. However, when states and territories are divided into slave and non-slave, it becomes much lower (—.124 and —.089 respectively) and is not significant at all.

Perhaps a better way to examine the effect of immigration is to match the proportion of foreigners or of the foreign born with the change in the white refined birth ratio. As the first step, the proportion of foreigners at a census date and the change in the white refined birth ratio during the two decades preceding the census date in a state or territory were compared. With states and territories standardized with respect to the initial level of fertility, the coefficient of standardized rank correlation, τ_s, for the proportion of foreigners in 1820 and the absolute decline in the refined birth ratio between 1800 and 1820 is 0, and for the

TABLE V-17

NUMBER OF FOREIGNERS NOT NATURALIZED, 1820, AND NUMBER OF THE FOREIGN BORN, 1860, BY STATE OR TERRITORY: UNITED STATES

State or territory	*1820* Foreigners not naturalized	*1820* Ratio to total white population	*1860* Foreign born	*1860* Ratio to total white population
New England				
Maine	1,680	0.57%	37,453	6.0%
New Hampshire	124	0.05	20,938	6.4
Vermont	935	0.40	32,743	10.4
Massachusetts	3,425	0.66	260,106	22.2
Rhode Island	237	0.30	37,394	21.9
Connecticut	568	0.21	80,696	17.9
Middle Atlantic				
New York	15,101	1.13	1,001,280	26.1
New Jersey	1,529	0.59	122,790	19.0
Pennsylvania	10,728	1.05	430,505	15.1
South Atlantic				
Delaware	331	0.60	9,165	10.1
Maryland	3,776	1.45	77,529	15.0
Virginia	2,142	0.35	35,058	3.4
North Carolina	415	0.10	3,298	0.5
South Carolina	1,205	0.51	9,986	3.4
Georgia	453	0.24	11,671	2.0
Florida			3,309	4.3
East North Central				
Ohio	3,495	0.61	328,249	14.2
Indiana	833	0.57	118,284	8.8
Illinois	598	1.11	324,643	19.0
Michigan	656	7.63	149,093	20.3
Wisconsin			276,967	35.8
East South Central				
Kentucky	529	0.12	52,799	5.7
Tennessee	312	0.09	21,226	2.6
Alabama	162	0.19	12,352	2.4
Mississippi	181	0.43	8,558	2.4
West North Central				
Minnesota			58,728	34.7
Iowa			106,077	15.7
Missouri	497	0.89	160,541	15.1
Dakota			1,774	68.9
Nebraska			6,351	22.1
Kansas			12,691	11.9

State or territory	1820 Foreigners not naturalized	1820 Ratio to total white population	1860 Foreign born	1860 Ratio to total white population
West South Central				
Arkansas	34	0.27	3,600	11.1
Louisiana	3,145	4.29	80,975	22.7
Texas			43,422	10.3
Mountain				
Colorado			2,666	7.8
New Mexico			6,723	8.1
Utah			12,754	31.8
Nevada			2,064	30.3
Pacific				
Washington			3,144	28.2
Oregon			5,123	9.8
California			146,528	45.3

Source: U. S. Census Office, *Census for 1820*, p. 1; *Do.*, *Population of the United States in 1860*, Washington 1864, pp. 606-607.

proportion of the foreign born and the absolute change in fertility between 1840 and 1860 it is .106.[48]

As the second step, the proportion of foreigners at a census date and the change in fertility during the two decades centering on the census date were compared. The coefficients of standardized rank correlation, standardized with respect to the initial level of fertility, are still small; for the earlier period being .238 and for the latter .064.[49]

Finally, it might be suspected that, though immigration was not a major factor in determining fertility, it may have exerted a minor influence which was over-shadowed by the dominant forces of other socio-economic variables. This hypothesis has to

[48] As in the preceding section, if the number of states and territories is between $10(n-1)$ and $10n$, n being an integer, states and territories $(n+1)$ positions or less apart in ranking with respect to the standardized variable are matched. The number of states and territories represented is 16 for the coefficient for 1800-1820 and 27 for the coefficient for 1840-1860.

[49] The number of states and territories represented is 16 for the former coefficient and 26 for the latter. Willcox's ratios of white children under 5 years of age to white women aged 15-44 were used as estimates of fertility in 1850 and 1870. See U. S. Bureau of the Census, *Proportion of Children in the United States*, pp. 17-18.

be rejected. For τ_s for the proportion of foreigners and the white refined birth ratio in a state or territory in 1820 standardized with respect to population density, which, at that time, was the most important factor in explaining fertility, is —.195 [50] and τ_s for the proportion of the foreign born and fertility in 1860 standardized with respect to the degree of industrialization, the most important factor at that time, is —.026.[51]

All the foregoing cross-sectional analyses are marred by the fact that, whereas the hypothesis has to do with the relationship between the birth rate of the native white population and immigration, the test can be made only on the relationship between general white fertility and immigration. Since immigrant fertility is known to have been higher than native fertility, at least for the period after the Civil War, a larger amount of immigration as such may have tended to make general fertility higher. Therefore, a rather strong inverse association between native fertility and immigration may be masked. Our justification for substituting general fertility for native fertility is that in the period 1800 - 1860 (1) immigrant fertility probably was not so much higher than native fertility as in later years and (2) the proportion of foreigners was smaller than in later years.

In view of the above difficulty, only the following can be said. Although it is reasonable to assume that immigration, by reducing the availability of easily accessible land and facilitating industrialization and urbanization,[52] helped reduce native fertility, this hypothesis can not be strongly supported by the statistical information available. A stronger hypothesis that immigration was the most important cause of the fall in native fertility definitely has to be rejected; in the period under consideration, particularly before 1840, only a minor part of the population increase was attributable to immigration.[53]

[50] The number of states and territories represented is 23.

[51] The number of states and territories represented is 33.

[52] To some extent a greater incidence of immigration in a particular area may have been the *result* of industrialization and the availability of jobs for industrial workers in that area.

[53] The contribution of immigration towards the total population increase was less than 5% before 1830, 13.5% in 1830-1840, 26.5% in 1840-1850, and 34.7% in 1850-1860. (Thompson and Whelpton, *op. cit.*, p. 132.)

6. *Summary and Conclusion*

In this chapter a number of hypotheses were examined: (1) that industrialization-urbanization was inversely associated with fertility, (2) that population density, which presumably represented the degree of difficulty with which an individual could acquire land not far from a place where he lived, was inversely associated with fertility, (3) that the average income per person aged 10 or older was inversely associated with fertility, and (4) that the influx of immigrants caused the decline in native fertility.

The first three hypotheses were supported by statistical evidence in cross-section analysis for every year for which data were available. Generally speaking the correlation between population density, or the number of persons per 1,000 acres of arable land, and the refined birth ratio was closer than the correlations between the degree of industrialization (or urbanization) and the refined birth ratio or between the average income per person aged 10 or older and the refined birth ratio. However, since the correlation between population density and the refined birth ratio became weaker over time, the absolute value of its coefficient became approximately the same as that of the coefficient for industrialization-urbanization and the refined birth ratio towards the end of the period under consideration.

The correlation between average income and the refined birth ratio was much weaker. Moreover, the correlation disappeared when observations were standardized with respect to the degree of urbanization. A closer look at the relationship revealed that average income, in 1840, might have been inversely associated with fertility in more urbanized areas and positively associated with fertility in rural areas.

To measure the association between the changes in two variables over time, a technique called standardized rank correlation was devised. According to this measure, there was a close correlation between the change in population density and the change in the refined birth ratio during the first half of the period under consideration. The association became weaker afterwards. There seems to have been little correlation between the change in the degree of urbanization and the change in the

refined birth ratio during the first half of the period. During the latter half, a positive association emerged but the coefficient of standardized rank correlation was not very large. It was after 1860 that a close association between the change in the degree of urbanization and the change in the refined birth ratio emerged.

Hypothesis (4) was more difficult to test because of the inadequacy of available data. Though it seemed reasonable to assume that immigration, by reducing the availability of easily accessible land and facilitating industrialization and urbanization, helped reduce native fertility, this hypothesis was not strongly supported by the statistical data available. A stronger hypothesis that immigration was the most important cause of the fall in native fertility did not seem to be tenable.

Selectivity of migration may have played a part in creating the geographical differentials in fertility. For example, those who migrated to the frontiers may have been the most sturdy and prolific type of people, while those who migrated to cities may have been persons of weaker physique. Again the selectivity of migration with respect to sex—males tended to go to the frontiers, females to cities—may have affected fertility as shown by the refined birth ratio. It is likely that a part of the association between urbanization-industrialization and the refined birth ratio and between population density and the refined birth ratio could be explained by this factor. However, in view of the existence of the North-South differentials in fertility which the selectivity of migration can not explain, the importance of this factor may not have been very great.

Thus, the following set of hypotheses may be presented as explaining most plausibly, within the framework of the data examined in this study, the levels and trends in the refined birth ratio in American states and territories in the period 1800-1860. Though we are not in a position to claim that these are *the* explanations of what happened in the birth rates in the United States, they are at least consistent with most of the statistical data examined so far, capable of explaining the higher birth rate in the United States than in Europe in the early decades of the nineteenth century or earlier, and in accord with the modern interpretation of the frontier thesis to the effect that the disappearance of the frontier was a gradual process and started much earlier than 1890.

(1) In the early decades of the nineteenth century, the availability of easily accessible land within the settled areas was a major determinant of the refined birth ratio of the white population in the United States. Fertility tended to be higher in places where it was easier to obtain new land nearby and, conversely, it tended to be lower in places where there was less free or cheap land. Over time, as the difficulty of obtaining new land within the settled areas increased with the growth of population, fertility was reduced.

(2) After the middle of the nineteenth century, though the availability of easily accessible land probably continued to be a factor in affecting fertility, another socio-economic force, industrialization-urbanization, assumed a major role as a determinant of fertility.

It must be emphasized that these hypotheses do not exclude the possibility of the existence of other major determinants of fertility. In fact, the relatively low refined birth ratios in new states and territories in 1860 compared with the refined birth ratios in new areas in 1800 suggest that other factors—for example, propagation of the knowledge of contraceptive techniques and decline in the importance of religious inhibitions—may have been at work.

APPENDIX I

Proportion of Married Women among Total Women Aged 16-44, Refined Birth Rate,[a] Marital Birth Rate,[b] and Population Density,[c] by County[d]: New York, 1825 and 1845

County	Proportion of married women 1825 (%)	Proportion of married women 1845 (%)	Refined birth rate 1825 (per 1,000)	Refined birth rate 1845 (per 1,000)	Marital birth rate 1825 (per 1,000)	Marital birth rate 1845 (per 1,000)	Population density 1825 (per square mile)	Population density 1845 (per square mile)
Albany	54.8	59.3	171.9	150.5	313.9	253.6	92.7	167.0
Allegany	74.7	64.1	267.5	166.9	358.3	260.8	16.2	35.8
Broome	66.4	62.3	235.2	160.2	354.3	258.1	19.8	36.8
Cattaraugus	77.9	64.5	279.6	177.3	358.8	275.1	6.8	23.7
Cayuga	60.1	56.8	195.1	140.9	324.7	248.1	78.4	91.0
Chautauque	76.1	61.1	261.6	147.9	343.7	241.9	20.0	45.1
Chenango	59.5	57.1	195.6	139.8	328.9	244.9	43.9	51.2
Clinton	66.2	65.8	192.8	211.1	291.5	320.7	13.6	29.4
Columbia	52.5	56.7	145.1	138.1	276.1	261.4	63.9	70.7
Cortland	64.2	58.8	201.6	139.7	314.2	237.8	42.7	52.8
Delaware	60.7	56.1	214.5	120.4	353.6	214.7	20.7	25.9
Dutchess	53.0	53.5	154.6	133.5	291.6	249.4	64.4	76.0
Erie	72.2	64.2	258.9	167.8	334.8	261.3	25.6	82.8
Essex	65.0	62.3	218.5	188.2	336.4	301.9	9.0	14.1
Franklin	69.4	63.4	220.8	204.9	318.5	323.3	5.3	12.4
Genesee	68.6	57.8	215.2	133.3	313.7	230.4	43.8	60.0
Greene	58.5	57.6	184.4	160.9	315.0	279.1	51.6	62.8
Herkimer	58.5	60.1	193.6	143.5	331.1	238.7	25.6	29.0
Jefferson	66.7	60.5	227.0	164.9	340.4	272.7	44.4	69.3
Kings	60.1	60.2	133.6	153.0	222.3	254.2	108.1	568.7
Lewis	60.7	59.7	203.6	160.7	335.5	269.2	11.6	20.1
Livingston	64.0	55.7	195.5	145.7	311.9	261.6	51.9	72.2
Madison	58.0	57.6	180.4	136.8	310.9	237.6	57.9	66.6
Monroe	65.1	62.2	216.2	156.3	332.1	251.2	65.2	111.2
Montgomery	71.7	57.7	183.5	155.4	315.0	269.1	39.7	46.8
New Yok	51.6	55.9	104.4	127.9	202.4	228.9	7636.1	17066.7
Niagara	73.2	65.8	246.6	170.9	336.6	259.2	31.4	77.1
Oneida	53.7	57,2	170.7	146.1	318.0	255.5	50.9	74.6
Onondaga	62.6	62.4	202.5	151.3	323.5	242.7	92.8	134.5
Ontario	57.9	55.5	187.4	134.0	323.9	241.4	59.0	67.1
Orange	54.2	53.8	170.0	146.5	313.7	272.4	68.5	85.7
Orleans	75.2	62.0	299.8	148.9	398.9	240.1	39.1	69.9
Oswego	63.2	66.6	201.7	173.4	319.0	260.3	19.9	53.9
Otsego	57.9	56.3	183.8	131.6	317.8	233.7	51.2	52.6
Putnam	61.8	60.6	184.8	164.2	298.8	271.0	47.1	52.6
Queens	54.6	58.5	144.1	142.6	263.9	244.0	57.2	89.6
Rensselaer	56.2	58.6	170.6	157.9	303.6	269.6	77.0	109.0
Richmond	58.1	57.7	156.6	127.3	269.5	220.7	77.0	177.5

County	Proportion of married women 1825 (%)	1845 (%)	Refined birth rate 1852 (per 1,000)	1845	Marital birth rate 1825 (per 1,000)	1845	Population density 1825 (per square mile)	1845
Rockland	66.7	68.1	167.0	166.8	250.5	244.9	49.8	85.5
Saratoga	56.7	55.4	159.4	131.8	281.3	237.7	47.0	53.7
Schenectady	56.3	55.9	188.9	144.7	335.4	258.9	71.5	92.4
Schoharie	64.9	60.7	218.4	169.5	336.5	279.1	45.9	57.5
Seneca	64.3	56.4	216.8	164.5	345.4	291.6	47.3	58.6
St. Lawrence	70.2	62.0	222.3	188.8	316.6	304.6	13.8	31.2
Steuben	70.5	65.5	255.8	188.9	362.9	288.3	12.0	27.2
Suffolk	55.1	61.6	142.3	153.5	258.1	249.2	29.7	43.3
Sullivan	70.0	66.3	256.3	210.9	366.3	318.1	10.7	19.3
Tioga	65.7	62.3	209.5	173.7	318.8	278.8	20.0	46.3
Tompkins	63.6	57.8	211.8	132.9	332.9	230.0	70.3	81.5
Ulster	61.9	61.1	200.4	181.1	323.6	296.4	33.5	51.2
Warren	63.8	62.5	243.7	185.2	381.9	296.2	13.2	18.0
Washington	53.2	52.0	169.0	128.6	318.0	247.3	50.0	51.6
Wayne	69.4	62.6	221.4	158.2	318.9	252.7	52.7	83.7
Westchester	52.7	55.4	138.6	144.5	263.1	260.9	69.0	99.1
Yates	63.1	60.4	234.2	158.4	371.0	262.3	57.0	87.6
New York State	59.7	58.8	182.8	150.1	306.2	254.9	36.9	59.5

Note: *a.* Refined birth rate in this table is the number of yearly births per 1,000 women aged 16-44. *b.* Marital birth rate in this table is the number of yearly births per 1,000 married women aged 16-44. *c.* Population density in this table is the number of persons per square mile of all sorts of land. *d.* In 1845, Wyoming is included in Genesee, Chemung in Tioga, and Fulton and Hamilton in Montgomery.

Source: New York (State), Legislature, Senate, *Journal*, 49th Session, 1826, Albany 1826, Tables X and Z. New York (State), Secretary of State, *Census of the State of New York for 1845*, Albany 1846, Recapitulation—No. 1.

APPENDIX II

AGE-DISTRIBUTION[a] OF WHITE WOMEN AGED 15-50, BY STATE OR TERRITORY: UNITED STATES, 1830-1860

State or territory Age:	1830 15-20	1830 20-30	1830 30-40	1830 40-50	1840 15-20	1840 20-30	1840 30-40	1840 40-50
New England								
Maine	23.7%	37.7%	23.6%	15.0%	23.3%	35.4%	24.4%	16.8%
New Hampshire	21.8	36.1	24.5	17.5	21.3	34.0	25.2	19.5
Vermont	23.1	36.9	23.8	16.2	22.2	34.2	25.6	18.1
Massachusetts	21.6	37.8	23.9	16.7	20.5	37.7	25.0	16.8
Rhode Island	22.7	37.5	23.4	16.4	20.9	37.5	24.7	16.9
Connecticut	21.7	36.0	24.4	17.9	21.0	34.5	25.6	18.9
Middle Atlantic								
New York	23.7	38.1	23.6	14.5	23.0	37.9	24.0	15.1
New Jersey	23.9	36.8	23.7	15.7	23.0	36.8	23.9	16.4
Pennsylvania	24.8	37.9	22.8	14.5	23.9	38.1	23.0	15.1
South Atlantic								
Delaware	24.0	38.9	22.5	14.5	22.7	38.9	23.6	14.8
Maryland	24.8	37.5	22.9	14.9	22.6	38.2	23.8	15.4
Virginia	24.8	38.1	22.4	14.6	24.2	37.5	22.9	15.4
North Carolina	24.9	37.9	22.3	14.9	23.6	37.8	22.7	15.9
South Carolina	25.7	37.2	22.8	14.4	24.7	37.5	22.6	15.3
Georgia	26.2	38.2	22.2	13.4	26.0	36.9	22.8	14.3
Florida	24.9	39.1	22.9	13.1	24.2	40.7	22.3	12.9
East North Central								
Ohio	26.4	37.8	22.0	13.8	25.2	37.9	22.5	14.5
Indiana	26.0	38.4	22.6	13.0	25.5	38.1	22.6	13.8
Illinois	25.9	40.0	22.0	12.1	24.5	39.5	23.1	12.9
Michigan	23.5	41.6	22.9	11.9	22.8	39.5	25.0	12.9
Wisconsin					20.2	45.6	23.9	10.3
East South Central								
Kentucky	26.8	37.9	21.2	14.0	26.0	37.5	22.4	14.1
Tennessee	27.2	38.2	20.9	13.6	26.1	37.7	22.2	14.0
Alabama	26.4	38.4	22.7	12.5	26.4	37.7	22.3	13.5
Mississippi	26.6	38.2	22.5	12.6	25.1	40.7	22.1	12.1
West North Central								
Iowa					23.8	43.6	21.5	11.3
Misouri	25.7	39.3	22.9	12.0	25.4	39.4	22.3	12.9
West South Central								
Arkansas	25.3	41.5	22.4	10.9	26.4	39.7	22.4	11.6
Louisiana	25.9	38.2	23.2	12.7	24.0	41.2	22.4	12.4
U. S.	24.6	37.9	22.9	14.7	23.8	37.7	23.4	15.1

APPENDIX II (Continued)

State or territory Age:	1850 15-20	20-30	30-40	40-50	1860 15-20	20-30	30-40	40-50
New England								
Maine	23.7%	34.2%	23.8%	18.3%	22.6%	35.7%	23.4%	18.2%
New Hampshire	22.3	34.4	23.7	19.5	20.5	35.2	24.6	19.8
Vermont	21.8	33.4	25.0	19.8	21.9	33.8	24.9	20.0
Massachusetts	20.0	38.3	24.9	16.9	18.2	37.7	26.6	17.6
Rhode Island	19.5	37.8	25.4	17.4	18.8	36.6	26.2	18.5
Connecticut	20.1	36.2	25.0	18.8	18.8	36.4	26.2	18.6
Middle Atlantic								
New York	21.3	38.2	24.5	16.0	19.6	36.9	26.5	16.9
New Jersey	21.9	36.7	24.6	16.7	20.4	36.5	26.2	16.9
Pennsylvania	22.5	37.4	24.1	16.1	22.1	36.3	24.8	16.8
South Atlantic								
Delaware	22.3	35.8	25.3	16.6	22.2	36.2	23.9	17.6
Maryland	21.4	36.4	25.5	16.6	21.8	35.6	25.2	17.5
Virginia	23.5	36.5	23.5	16.4	23.2	36.4	23.8	16.6
North Carolina	23.5	36.7	23.5	16.7	22.6	36.8	23.7	16.7
South Carolina	23.8	36.6	23.4	16.2	23.7	36.6	23.6	16.2
Georgia	25.8	37.3	21.9	14.9	25.4	37.1	22.8	14.7
Florida	24.4	37.7	23.7	14.2	25.6	37.2	22.5	14.7
East North Central								
Ohio	24.3	36.9	23.4	15.4	23.8	36.1	24.0	16.1
Indiana	25.4	36.9	22.9	14.7	24.9	36.7	23.4	15.1
Illinois	24.2	37.2	23.9	14.6	22.7	37.8	24.9	14.6
Michigan	23.1	35.5	25.2	16.2	22.7	36.6	24.6	16.0
Wisconsin	20.4	37.8	26.8	15.0	21.0	34.0	28.2	16.8
East South Central								
Kentucky	25.0	37.6	22.6	14.8	24.6	36.7	23.6	15.1
Tennessee	25.9	37.1	22.0	14.9	24.9	37.6	22.7	14.7
Alabama	26.4	37.4	22.0	14.3	25.9	37.6	22.4	14.1
Mississippi	25.7	37.7	22.6	14.0	26.1	37.2	22.4	14.4
West North Central								
Minnesota	19.6	47.9	21.3	11.1	17.6	40.0	29.1	13.2
Iowa	24.0	37.1	24.8	14.1	23.0	36.9	25.2	14.9
Missouri	24.6	38.1	23.4	13.9	23.5	38.4	23.9	14.1
Dakota					21.6	34.7	29.4	14.3
Nebraska					19.9	43.1	25.1	11.9
Kansas					21.4	43.0	23.8	11.9
West South Central								
Arkansas	26.3	37.7	21.7	13.2	26.0	38.4	22.5	13.2
Louisiana	20.9	41.2	25.2	12.6	21.4	37.7	26.3	14.4
Texas	25.1	38.4	22.9	13.6	24.6	38.0	23.7	13.6

State or territory	Age:	1850 15-20	1850 20-30	1850 30-40	1850 40-50	1860 15-20	1860 20-30	1860 30-40	1860 40-50
Mountain									
Colorado						15.0	49.8	26.2	9.0
New Mexico		24.9	40.8	21.4	12.9	20.7	41.9	23.8	13.6
Utah		26.0	34.8	23.4	15.8	19.9	36.4	27.2	16.5
Nevada						16.2	49.7	27.0	7.1
Pacific									
Washington						20.6	41.5	25.5	12.4
Oregon		24.4	37.4	25.4	12.8	24.2	37.3	25.0	13.6
California		22.4	40.8	25.2	11.6	14.9	43.5	30.3	11.4
U. S.		25.1	37.2	23.9	15.8	22.1	36.9	24.9	16.1

Note: *a.* Ages 15-50 = 100%.
Source: U. S. Censuses. Cf. Appendix III.

APPENDIX III

NOTE ON THE SOURCES OF STATISTICS OF POPULATION BY AGE, COLOR, AND STATE OR TERRITORY

Statistics of population by age, color, and state or territory were copied from the summary tables in the census volume on population for each census year. No effort was made to correct clerical errors in the summary tables except when the errors were easily detected internally, for example when the number of the total population was different from the sum of persons belonging to various age-groups. In case the correctness of the figures in summary tables was in doubt, state tables were examined. The only important revision of the summary table figures was made in the case of white males under 10 years of age in New York in 1800 which was given as 33,161 where it had to be 83,161.

Summary tables of population by age appear in the following pages of the census volumes.

1800: U. S. Census Office, *Second Census of the United States*, 1801, p. 2.

1810: U. S. Census Office, *Aggregate Amount of Persons within the United States in the Year 1810*, 1811, p. 1.

1820: U. S. Census Office, *Census for 1820*, 1821, p. 1.

1830: U. S. Census Office, *Fifth Census or Enumeration of the Inhabitants of the United States, 1830*, p. 162.

1840: U. S. Census Office, *Sixth Census, or Enumeration of the Inhabitants in the United States in 1840*, 1841, p. 474.

1850: U. S. Census Office, *The Seventh Census of the United States: 1850*, 1853, p. xlii.

1860: U. S. Census Office, *Population of the United States in 1860*, 1864, pp. 592-593.

1870: U. S. Census Office, *Ninth Census, Vol. II: The Vital Statistics of the United States*, 1872, pp. 608-618.

1880: U. S. Census Office, *Statistics of the Population of the United States at the Tenth Census: 1880*, 1883, pp. 552-645.

1890: U. S. Census Office, *Report on the Population of the United States at the Census: 1890*, Part II, 1897, pp. 6-103.

1900: U. S. Census Office, *Twelfth Census of the United States: 1900*, Vol. II, *Population*, Part II, 1902, pp. 6-109.

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